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ELECTRICALLY EXCITABLE REGION OF THE FOREBRAIN OF THE ALLIGATOR*

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The findings of J. B. Johnston, particularly those recorded in his paper, "Evidence of a Motor Pallium in the Forebrain of Reptiles,"[1] giving the results of the electrical stimulation of the forebrain of turtles and lizards, suggested twelve experiments on seven alligators varying in length from 2½ to 5 feet (76 to 152 cm.).

The exposure of the hemisphere of the alligator offers some difficulty because of the dense skull with a thick vascular inner table and ivory-like outer table covered by thin tightly adherent skin. An extensive exposure, however, may be made by dividing the skull in the midline and elevating two lateral bone flaps. These flaps can be returned to their original position and the same animal used for repeated experiments if care is exercised in the manipulation of the brain.

Movements have been recorded by photographs and tracings. In the photographic method a bromid paper was used and frequent exposures were made during the progress of movements. The apparatus (Fig. 1) was set up in a dark room with small electric bulbs placed on the animal along the midline from the nose to the tip of the tail and on each of the extremities. The position of the various parts was indicated on the photographic paper (Fig. 2) by dark spots corresponding to the position of the lights at the time of exposure. The apparatus (Fig. 3) used for making tracings, shown in Figures 4 and 5, was given up in the later experiments because of the greater ease in reading photographic records.

Normal progression movements were studied by photographic records (Fig. 6) with the alligator on the floor. A study of these records

*From the Neurological Laboratory of the Henry Phipps Psychiatric Clinic, Johns Hopkins University.

*A preliminary report read at the Forty-Ninth Annual Meeting of the American Neurological Association, Boston, Mass., May, 1923.

1. Johnston, J. B.: Evidence of a Motor Pallium in the Forebrain of Reptiles, J. Comp. Neurol. 26:475, 1916.

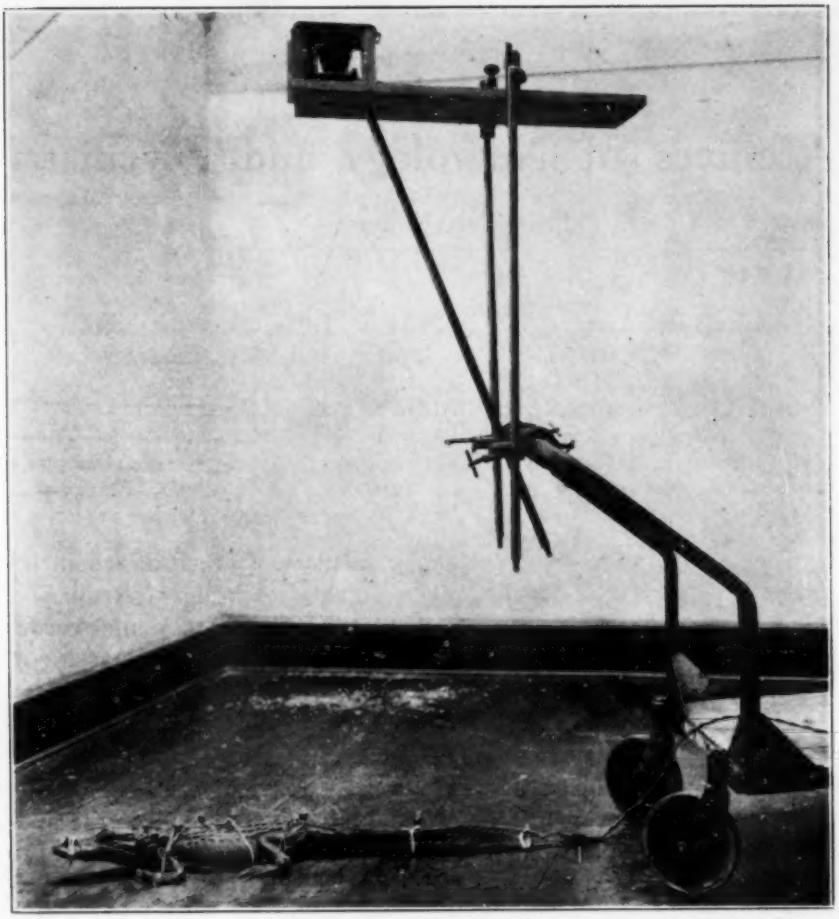

Fig. 1.—Portable camera arranged to record normal progression movements and movements excited by cortical stimulation.

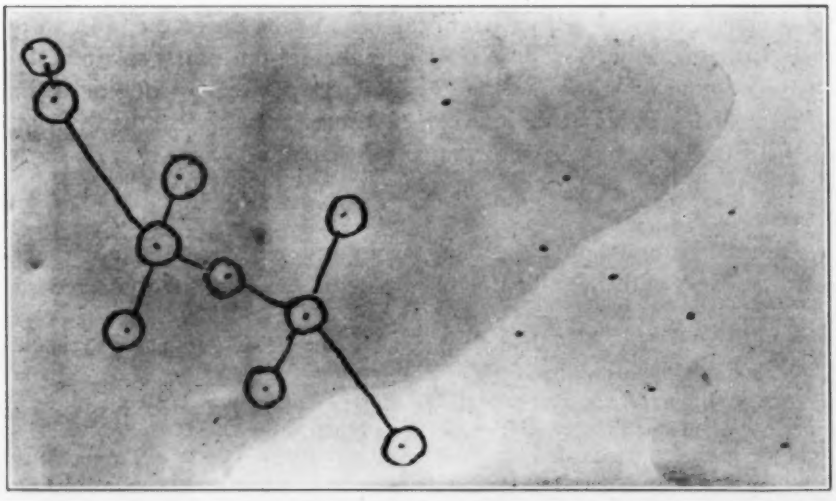

Fig. 2.—On the right, a photograph showing position of the head, tail and extremities of the alligator; on the left, a diagram made clearer by the addition of circles and lines.

shows that the fore leg on one side moved with the hind leg of the opposite side, while the head and tail deviated slightly from the midline position and usually in the opposite direction.

The area over which positive results were obtained, as shown in Figure 7, extended from the mesial over the dorsal surface to the dorsolateral border, tapering almost to a point at its outer extremity. It was not possible to produce movements of individual extremities, but the mesodorsal part seemed to be responsible for the head and tail while the outer portion of the area favored movements of the legs. The tail moved toward the side stimulated and the head toward the opposite side; these movements were associated with those of the legs which were similar to, but not typically normal, progression movements.

Natural swimming movements were observed also but because of technical difficulties were not photographed. The alligator was placed

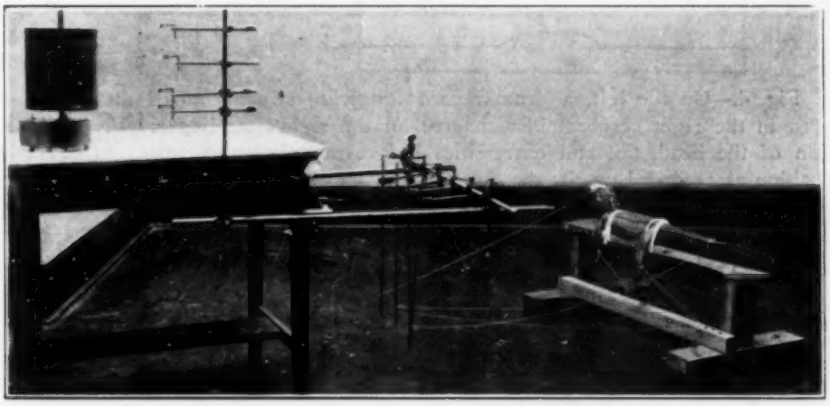

Fig. 3.—The alligator in position for recording, on the drum, movements of the head, tail, left fore and left hind leg by cortical stimulation.

in a running stream where sharp preference was shown to crawling on the bottom and resting, partly submerged, on the bank in the sun. If the water were shallow he would remain quiet for awhile then slowly crawl to land. When placed in deeper water he would sink to the bottom, then swim slowly to shallow water and crawl to the bank. When placed in a swift current the tail movements were pronounced; the tail would be quickly drawn from one side to the other, describing a half circle as shown in the stimulation experiments (Fig. 6). At times the proximal portion of the tail was pulled laterad and the distal part in the opposite direction giving the form of the letter S.

The question arose as to the dependence of progression on this focal stimulation, and in one animal the brain was divided at the middle

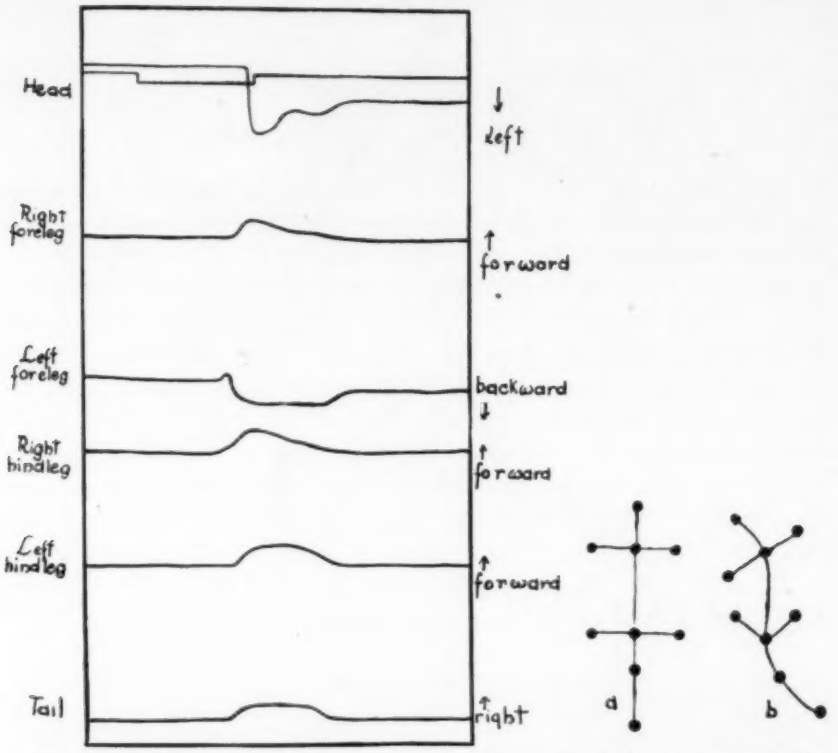

Fig. 4.—On the left, a drum record following stimulation of the excitable area in the right cerebral hemisphere; on the right: *a*, diagram of the position of the head, tail and extremities before stimulation; *b*, diagram of their position as recorded on the drum.

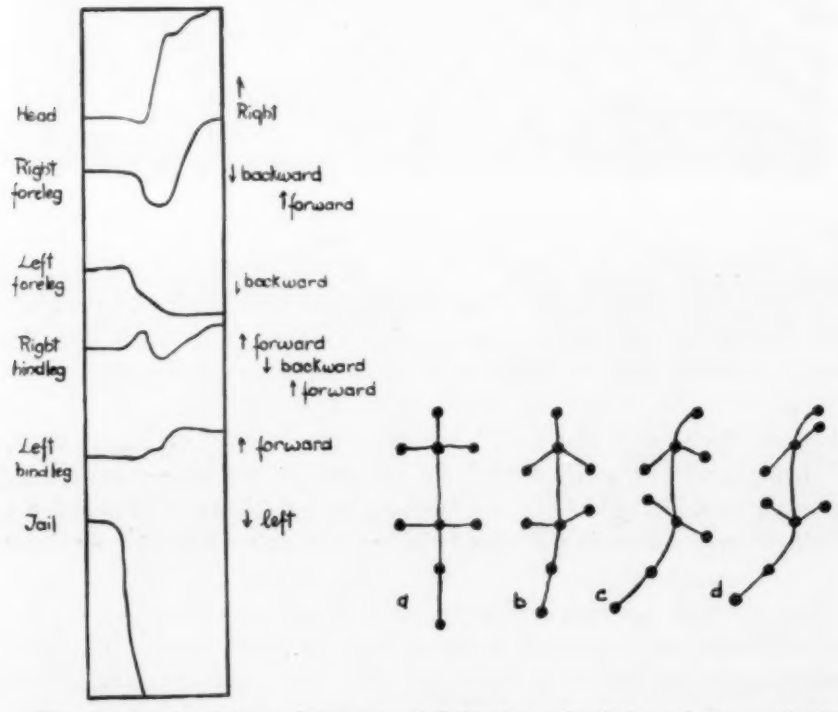

Fig. 5.—On the left, a drum record following stimulation of the excitable area in the right cerebral hemisphere; on the right: *a*, diagram of position of the head, tail and extremities before stimulation; *b*, *c*, and *d*, diagrams of stages of the position as recorded on the drum.

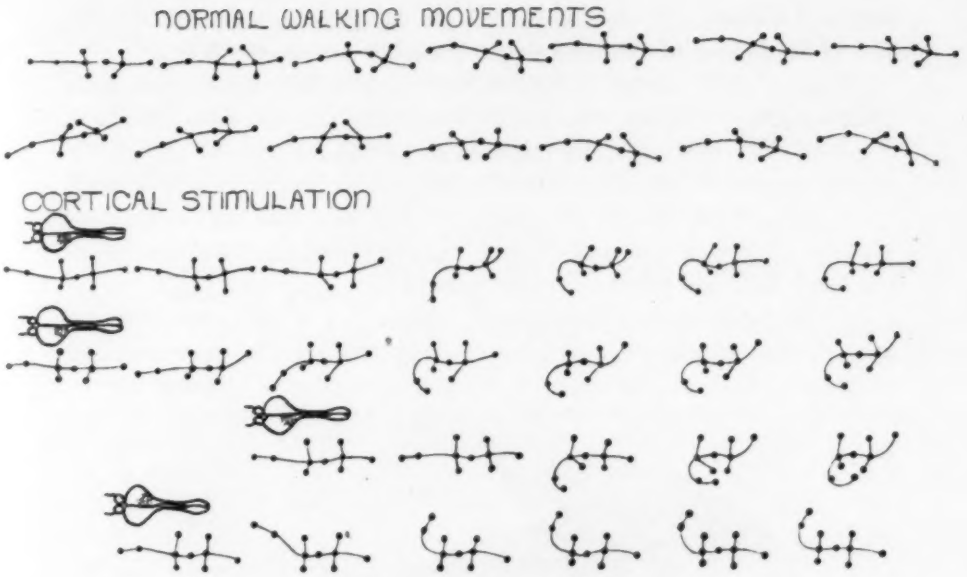

Fig. 6.—Photographic record of normal walking movements and movements produced by cortical stimulation in the right and left cerebral hemispheres. The area stimulated is indicated by small black dots.

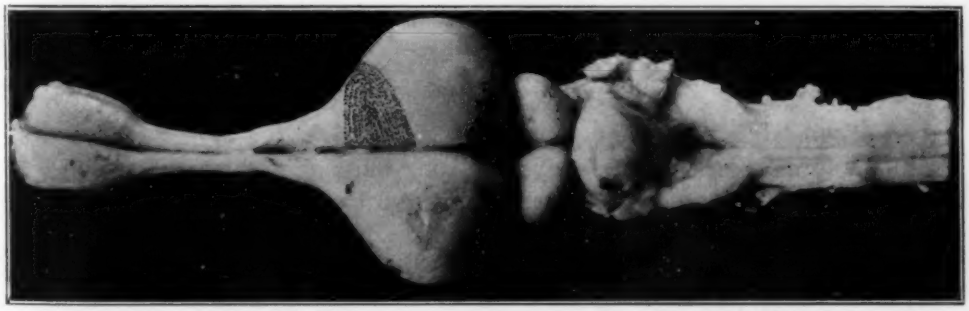

Fig. 7.—Small dots indicate the extent of the surface which gave positive electrical results. The inner part of the area was most responsive.

hind-brain segment and removed. In response to pain stimuli this animal exhibited normal progression movements, which, however, were not well coordinated, for he reared on the fore legs and made wide lateral excursions of the head which generally struck the floor.

With a view to determine whether progression movements were possible after complete removal of the brain, the specimen shown in Figure 7 was removed. In response to peripheral painful stimuli the animal responded, but the action was not that of progression. Figure 8 shows a usual position of this alligator. The head and tail have moved slightly to the same side and the fore legs are pulled closely to the side of the trunk with the palmar surface upward.

From the studies of Elizabeth C. Crosby,[2] it would seem that our area, outlined in Figure 7, does not coincide with the known cortical dis-

Fig. 8.—Position following painful stimuli after removal of the brain shown in Figure 7.

tricts. This area includes the anterior part of what she calls "general cortex," but extends mesiad into the hippocampus—in our experience the most active part of the field—and laterad slightly into the region of the pyriform lobe.

It will be our task to study further the rôle of the underlying structure.[3]

SUMMARY

Stimulation experiments on the forebrain of the alligator have brought out movements, closely simulating those of walking and swimming, from an area differing somewhat from that described by Johnston

2. Crosby, E. C.: The Forebrain of Alligator Mississippiensis, J. Comp. Neurol. & Psychol. **27**:325, 1916-1917.

3. Jan. 15, 1924: Experiments are under way, and, although they have not yet progressed to a point at which conclusions may be drawn, mention may be made of the fact that after complete removal of the area outlined in Figure 7 and electrical stimulation of the paraternormal region, characteristic responses have been obtained. Full results will be reported later.

in the lizard and the turtle. It does not coincide absolutely with any one definite cytoarchitectonic field, and further experiments in the underlying structures are called for.

That the animal is not dependent on this excitable area for locomotion is shown by the fact that walking is possible after the forebrain, midbrain and a portion of the hindbrain have been removed. Movements of the legs and tail are present after complete removal of the brain, but they do not resemble progression movements.

DISCUSSION

DR. FREDERICK TILNEY, New York: What part of the brain was removed in the last animal mentioned?

DR. CHARLES BAGLEY, Baltimore: The whole brain, the section being made at the cervical cord.

DR. TILNEY: This new method of exploring the coordination within the central nervous system is a brilliant one; a method that can be used in other animals besides the reptilian forms. I was not surprised, however, to find that in the animal with the brain removed so much coordination remains in locomotion. Probably the integrations are lower down in the stem and in the cord.

CEREBRAL EDEMA AND HEADACHE FOLLOWING CARBON MONOXID ASPHYXIA *

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INTRODUCTION

The purpose of this investigation has been to learn something of the physiologic mechanism causing a particular symptom: the headache suffered by persons exposed to carbon monoxid gas. Headache from this cause is extremely common among workers in special occupations: automobile repairing, blast furnace work, mining, etc., and with the increasing problem of motor exhaust gas in our city streets,[1] it becomes of especial interest to learn more exactly how the central nervous system is affected. This question is not only of clinical interest, but is of particular interest from a purely physiologic point of view. Carbon monoxid has been widely used by physiologists as an agent to produce anoxemia, and the laws governing its absorption and liberation from the blood have been carefully studied. By clinicians its action has been less well understood, but it has been thought by several authors to be directly toxic to nervous tissue. This has been recently disproved, at least in the special case investigated, by Haggard in an ingenious experiment. He was able to grow embryonic nerve cells in an atmosphere of 79 per cent. carbon monoxid.[2]

The injurious effects of the gas, as shown by Haldane in 1895,[3] are due to its power of depriving the tissues of oxygen through a reversible combination with hemoglobin, and no other harmful property has been demonstrated. The central nervous system is the first to suffer from oxygen lack, and the characteristic headache, often described as a "vise-like pressure about the temples," is one of the first symptoms noticed. That this is of clinical importance and may temporarily incapacitate the individual is evidenced by replies from seventeen automobile

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* From the Laboratories of Neuropathology, Harvard Medical School, Boston, and Applied Physiology, Yale University, New Haven.

1. Henderson, Y., and Haggard, H. W.: J. A. M. A. **81**:385 (Aug. 4) 1923.
2. Haggard, H. W.: Am. J. Physiol. **60**:244 (April) 1922.
3. Haldane, J.: J. Physiol. **18**:201, 1895.

manufacturers to a questionnaire sent out by the Chicago Health Department.[4] The report states that "when ventilation is bad there is an increase in the number of absentees, running as high as 33 per cent. off duty. . . . When the ventilation is good, sick leaves are sharply cut, and the workmen cease complaints." In our inquiry, the first question occurring to us was whether or not carbon monoxid caused a rise in intracranial pressure. Asphyxia due to other factors was known to cause such a rise,[5,6,7] but nothing in the literature about the action of carbon monoxid in this regard was found.

METHOD

The method of L. H. Weed[8] and collaborators was adopted for recording cerebrospinal fluid pressure. Dogs and cats were used. The cisterna magna was entered by a needle through the occipito-atlantoid ligament, the anesthetized animals being placed on the belly with the head slightly raised and held firmly by a jaw clamp. The body lay flat on a horizontal board, to the sides of which the legs were tied. A 17 gage needle (1 mm. bore) was found the best size for the puncture. After some experience it was learned that by exercising care to keep the point of the needle sharp and to insert it with its beveled edge parallel to the muscle fibers, plugging could be avoided without the use of a stilet, and thus all fluid loss prevented. The needle was connected by a flexible rubber tube to a vertical capillary glass tube of 1 mm. bore fastened to a meter stick. The connected system—needle, rubber tube, and capillary manometer—were filled with Ringer's solution up to or somewhat above the normal cerebrospinal fluid pressure (130 mm.).

For anesthesia, urethane was used at first on account of its greater convenience than ether, but we came to the same conclusion that Weed had reached, that a level base line for cerebrospinal pressure was seldom obtained with urethane. Ether was tried and found fairly satisfactory when the depth of anesthesia was carefully regulated. The ether was given from a Woulfe bottle by tracheal cannula which was provided with inspiratory and expiratory water valves. The carbon monoxid was administered from a spirometer or a Douglas bag and was passed through the ether bottle as illustrated in the diagram.

FINDINGS

A marked rise in cerebrospinal fluid pressure was observed shortly after the animal began breathing the carbon monoxid. This rise

4. Weekly Bulletin of the Chicago Department of Health **17**:149 (Sept. 1) 1923.
5. Bayliss, W. M., and Hill, L.: J. Physiol. **18**:345, 1895.
6. Dixon, W. E., and Halliburton, W. D.: J. Physiol. **48**:147, 1914.
7. Becht, F. C.: Am. J. Physiol. **51**:90 (Feb.) 1920.
8. Weed, L. H., and McKibben, P. S.: Am. J. Physiol. **48**:512 (May) 1919.

occurred in animals anesthetized either with ether or with urethane. The abruptness of the rise and the shape of the curve depended on the strength of the carbon monoxid mixture and on the condition of the animal. A series of fifteen similar experiments was carried out, a rise in cerebrospinal fluid pressure occurring in all. The following protocol and curves illustrate the changes observed:

PROTOCOL 1.—*May 29, 1922. Cat, Female*

Time	Remarks	C.S.F. Pressure	Pulse Rate
2:30	Ether and tracheotomy		
2:55	Cistern puncture. Lost about 1 drop of cerebrospinal fluid	60	
2:59	Good excursion of fluid in manometer with each cardiac systole	64	
3:00		64	
3:04		65	
3:07			170
3:08		65	180
3:11		65	200
3:13	Gas on with ether		
3:15		75	180
3:16		80	194
3:17		100	
3:18		128	170
3:19		141	
3:20		150	176
3:21		150	
3:22		153	154
3:23		155	
3:24		155	
3:25	No respiration for 1 minute	140	
3:25½	Gas off. Gasping	120	
3:26		111	
3:26½	Pulse irregular	105	124
3:28		73	
3:29		51	96
3:30		40	
3:31	Dead	30	

Having decided the main point—that a rise of intracranial pressure did occur with carbon monoxid asphyxia—it became of interest to ascertain if possible the causes of the rise. The physical laws of the "closed box" govern the volume of the three principal contents of the skull—blood, brain, and cerebrospinal fluid; the volume of any one of these may vary, but the total volume must remain unchanged, supposing the pressure to remain constant. Obviously, if one or more of the three increase in volume, without a compensating decrease in volume of one or both of the others, the pressure will rise. With this in mind,

three possibilities had to be considered to explain the observed asphyxial rise: cerebral congestion; increased secretion of cerebrospinal fluid; cerebral edema.

ANIMAL EXPERIMENTS

1. *Congestion.*—Methods: In order to determine the degree of vascular filling, two methods of examination were considered:

(a) Direct observation of the cortical vessels. This method was not used, however, in these experiments. The results of simple inspection of the vessels had already been given by Lewin,[9] who said, "Hyperemia of the cerebral vessels was observed through a window in the skull of a rabbit during carbon monoxid inhalation." Also, it was believed that inspection would not yield valuable results unless carried out in a quantitative way under as high magnification as possible and with the greatest precision. This we hope to do at a later date.

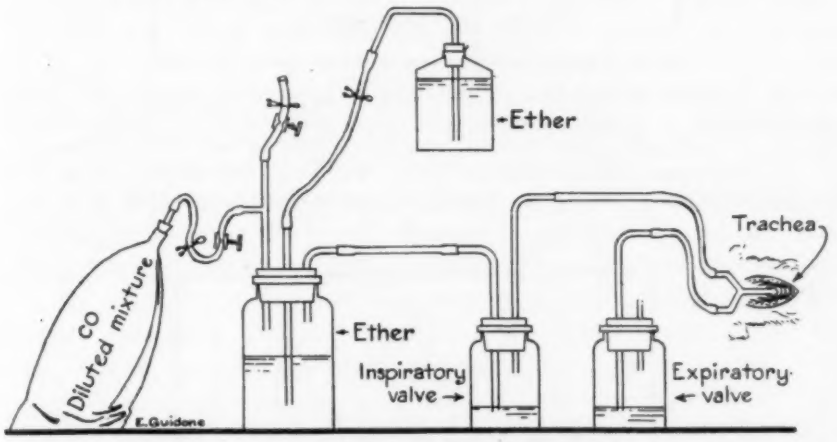

Fig. 1.—Apparatus for administration of carbon monoxid and ether. A gas of known strength can be given to an etherized animal without altering the ether concentration.

(b) Ophthalmoscopic observation of the retinal vessels, on the other hand, would show indirectly the presence of cerebral congestion, since obstruction by the latter to the venous outflow from the eye would give rise to a visible dilatation of the retinal veins. Cushing[10] has shown that this actually takes place. He fastened a blood pressure cuff about his neck and had an ophthalmologist examine his fundi during inflation of the cuff. At a pressure of 80 mm. of mercury a noticeable dilatation of the retinal veins was observed, and at 120 mm. a very marked dilatation, which disappeared at once on release of the

9. Lewin, L.: Die Kohlenoxydvergiftung, Berlin, Julius Springer, 1920, p. 324.

10. Cushing, H.: Am. J. M. Sc. **125**:1032, 1903.

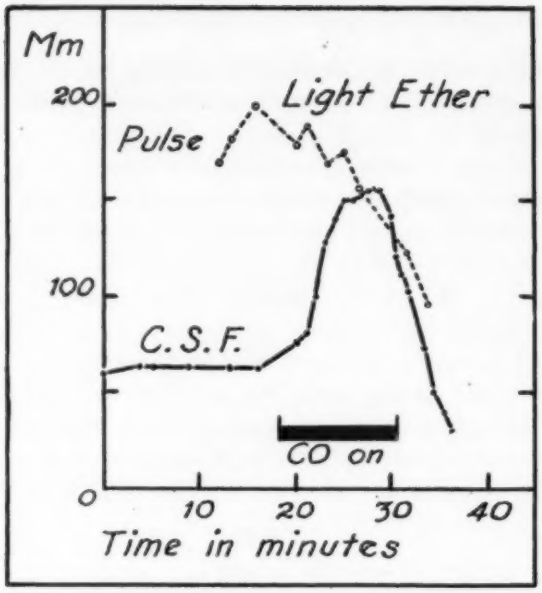

Fig. 2.—Experiment 1. Cat. Ether. Cistern puncture and manometer record in millimeters of water, showing abrupt asphyxial rise of cerebrospinal fluid pressure. Ordinates refer to pulse rate per minute as well as to millimeters of water of cerebrospinal fluid pressure. The rapid fall in pulse rate, after a brief acceleration, shows the typical vagus effect of oxygen lack.

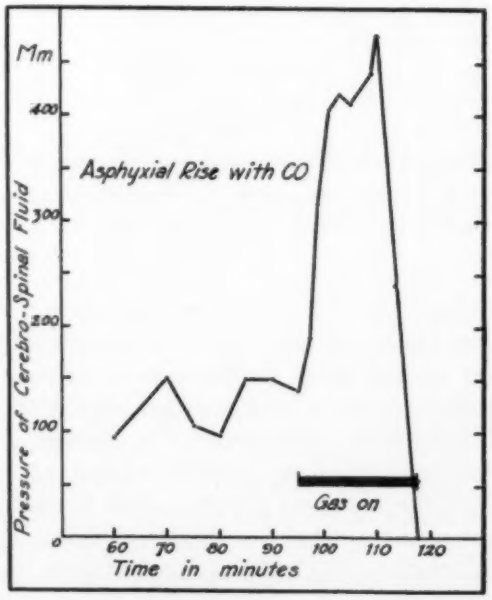

Fig. 3.—Experiment 2. Cat. Urethane. Cistern puncture and manometer record in millimeters of water. The irregular base line of cerebrospinal fluid pressure is characteristic of the urethanized animal. The sudden marked rise, however, directly after inhaling the gas is a true asphyxial response.

pressure about the neck. This retinal vein dilatation would, it is true, follow an intracranial pressure rise from any cause not only from congestion, but in our experiments the first rapid dilatation observed was certainly due to cerebral congestion rather than to any slower cause. This method of observation by ophthalmoscope had the advantage that it could be applied to human beings, and thus correlate the human with the animal findings. The eye grounds of a series of animals, twelve cats and two dogs, were observed therefore, before, during, and after gassing.

Findings: The normal fundus of both cats and dogs has the following peculiarities: the general color of the eye grounds is green with a metallic luster. This occurs in that part of the choroid which has no black pigment, called the tapetum.[11] The green extends well above the optic papilla and gradually becomes greenish-yellow, and in the upper sector orange. Below the papilla in the lower sector is a hazy purplish area partly obscuring the green. The normal optic papilla is much lighter than in the human fundus and the radiating vessels show considerable individual variations in caliber and course. In cats the surface of the papilla is finely pitted with shallow indentations like a thimble, and the physiologic cup is clearly visible.

Among the controls one cat was found with the typical orange fundi of congestion which we have attributed to increased intracranial pressure. Necropsy showed frontal sinusitis and both cavities filled with pus.

In cats strongly gassed with carbon monoxid, the large retinal veins converging toward the papilla dilate very noticeably, and often the papilla itself becomes first hyperemic and then pale. Occasionally during apnea and collapse from an overdose of the gas the arteries about the papilla are seen to constrict strongly. After severe prolonged asphyxia, especially during the recovery period, several changes take place in the fundus. The green area retreats from above downward to a point well below the papilla, all above this becoming yellow or orange except, however, a narrow green ring immediately about the papilla itself. The purplish area also becomes less distinct. This striking color change of the retina from green to orange is, we think, undoubtedly due to a congestion of the smaller vessels of the choroid, the congestion resulting from the increased intracranial pressure obstructing the venous outflow.

PROTOCOL 2.—*March 16, 1923. Cat, Adult Male. Fundi Normal*

Time	Observation
9:15	Given strong CO till unconscious, then put into box with dilute CO mixture.
9:30	Stuporous.

11. Davison, A.: Mammalian Anatomy—The Cat, Philadelphia, P. Blakiston's Son & Co., 1903, p. 236.

9:45 Unconscious. Fundi: veins dilated.
10:15 Unconscious, deep coma.
10:20 Long period of apnea. Resuscitation with 5 per cent. carbon dioxid and 95 per cent. oxygen.
Fundi: definite hyperemia of papilla. Veins dilated.
10:30 Semiconscious. More CO given.
10:55 Apnea. Artificial respiration. Fundi as before.
11:15 Unconscious.
11:50 Apnea for 5-10 minutes. Tracheotomy. Artificial respiration. Recovery. No more CO given.
12:12 Respiration regular.
Eyes: upper two thirds of fundus has become orange leaving a narrow green ring about the papilla. Papilla pink. Retinal veins dilated.
12:15 Periodic respiration.
12:20 Cheyne-Stokes respiration.
12:40 Breathing quiet and regular. Semiconscious. Fundi same.
1:00 Lying with eyes closed. Lethargic but can be roused.
Eyes: Fundi orange as in last note. Papillae normal. Veins dilated.
2:15 General condition same. Fundi same.
Decapitated. Necropsy 15 minutes postmortem showed congested cortical veins. No distention of cerebral ventricles. Brain section fixed in Zenker's solution.
One-half brain fixed in a 10 per cent. dilution of liquor formaldehydi.

Causes of Cerebral Congestion: Before leaving the question of congestion, it seemed worth while to try to find out what caused it. Among other possibilities it was thought that it might be due to increased intrathoracic pressure from spasm of the chest muscles during asphyxia and a consequent obstruction to blood flow in the large veins of the chest, and thus a backing up of pressure in the jugulars and in the intracranial venous sinuses. In order to rule this out the following experiment was done: under urethane anesthesia and artificial respiration, a cat's thorax was widely opened bilaterally and changes in cerebrospinal fluid pressure were recorded during carbon monoxid inhalation.

Findings: It was found that the cerebrospinal fluid pressure rose in spite of the open thorax. Some other factor than increased thoracic pressure must therefore explain the cerebrospinal fluid rise. Such a possible factor was found in the arterial pressure which in the open chest experiment rose synchronously with the cerebrospinal fluid pressure during the asphyxial period, this arterial pressure rise being in turn due to the well known mechanism of splanchnic vascular constriction in response to anemia of the vasomotor center. In the open chest experiment, with sudden changes in cerebral venous pressure ruled out, the parallelism between arterial and cerebrospinal fluid pressures can readily be seen. This is illustrated in Figure 4.

2. *Increased Secretion of Cerebrospinal Fluid.*—The only evidence obtained which bore on this question was the necropsy finding that

the cerebral ventricles were not distended after prolonged gassing. The observed rise in cerebrospinal fluid pressure could all be explained by congestion or by edema, but an additional secretion of fluid was not ruled out.

3. *Cerebral Edema.*—Discussion: The difficulties surrounding this problem are many and are due largely to anatomic considerations. The rigid skull strictly limits wide variations in brain bulk. A 3 per cent. to 8 per cent. encroachment on the intracranial contents has been shown by a number of workers to result in death.[12] Also the volume of cerebrospinal fluid and its rate of secretion and elimination are unknown.

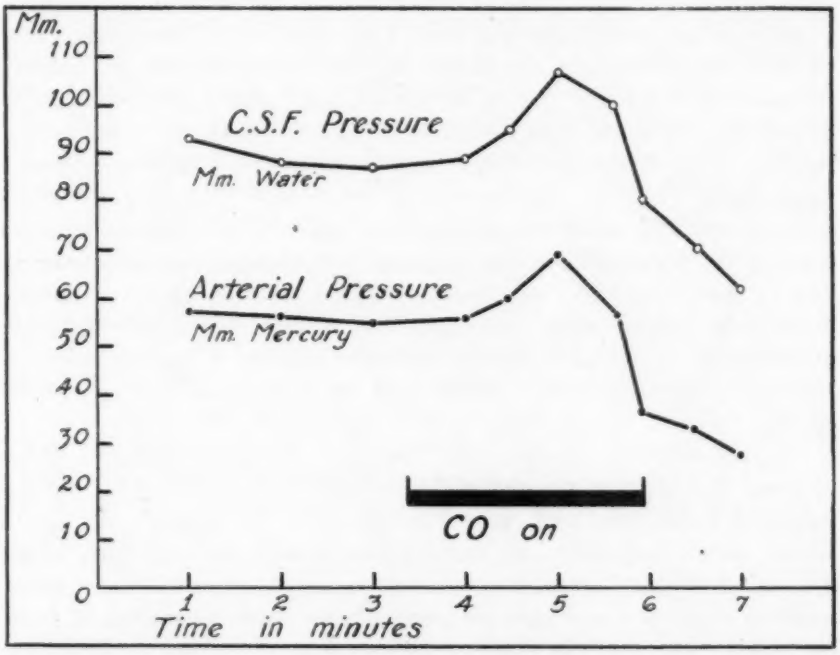

Fig. 4.—Experiment 4. Cat. Urethane. Cistern puncture. Open chest (bilateral). Artificial respiration. Carotid arterial pressure in millimeters of mercury and cerebrospinal fluid pressure in millimeters of water, plotted so that ordinates refer to millimeters of mercury in the former case and to millimeters of water in the latter. The parallelism is clearly shown between the asphyxial rise in arterial and in cerebrospinal fluid pressures when, as in this case, sudden changes in venous pressure are eliminated.

Another obstacle is the difficulty of controlling experimentally the cerebral blood supply. In 1901, Cannon,[13] studying cerebral edema

12. Hill, L.: The Cerebral Circulation, London, J. & A. Churchill, 1896, p. 163.

13. Cannon, W. B.: Am. J. Physiol. **6**:118, 1901.

following trauma, concluded that "in conditions of impaired nutrition" (the critical feature being lack of oxygen) "tissues undergo internal changes leading to increased osmotic pressure and thereby to increase of water content and greater size. The swelling takes place by means of a force much greater than blood pressure and since the brain lies in a rigid case, swelling tends to compress the blood vessels, thus further cutting off oxygen and leading to additional swelling." Of recent work, that of Weed and McKibben [14] is of great importance. By injection of hypotonic or hypertonic solutions into the blood stream they were able to cause at will a swelling or shrinkage of the brain. These changes reached their maximum in one-half to one hour after the injection and persisted for several hours. All evidence pointed toward a passage of water into and out from the tissue as the immediate cause of these volume changes, the underlying cause being the changed osmotic pressure of the blood due to the injections. Pathologic evidence of edema has been previously reported. Lewin [8] says, "Edema of the meninges and brain has often been a result" (of carbon monoxid poisoning).

Our methods of attack on this problem were as follows: (a) to observe the brain through a trephine hole, noting volume changes; (b) to study the effect of hypertonic saline solution on three things: brain bulk, eye grounds, and compression symptoms; (c) histologic examination of gassed brains in search of edema; (d) desiccation of brains to determine water content and hence evidence for or against edema.

(a) Observation of the Brain Through a Trephine Hole: In order to avoid complicating the picture by the use of any other drug, carbon monoxid itself was used as an anesthetic. The animal was given strong carbon monoxid until unconscious, the gas stopped just before the period of apnea set in, a tracheal tube quickly inserted, and a dilute mixture of carbon monoxid, usually 0.3 per cent., administered from a Douglas bag with inspiratory and expiratory valves as described previously. Keeping the animal thus unconscious, the skull was trephined and the dura opened. The trephine was then covered with a pad of cotton moistened with normal saline solution and the brain kept under observation during gassing and subsequent recovery, sometimes for several hours.

It was found difficult to maintain prolonged deep anesthesia without occasional failure of respiration. When this occurred the administration of a mixture of 5 per cent. carbon dioxid with 95 per cent. oxygen during artificial respiration, as suggested by Henderson and Haggard,[15] greatly facilitated resuscitation.

14. Weed, L. H., and McKibben, P. S.: Am. J. Physiol. **48**:531 (May) 1919.
15. Henderson, Y., and Haggard, H. W.: J. A. M. A. **79**:1137 (Sept. 30) 1922.

A series of three dogs and six cats was observed in this way. Of these all showed some bulging of the brain into or above the trephine opening, except one dog which had been suffering for days from a severe diarrhea and had obviously lost much body fluid. Most of the others showed a moderate or slight bulging, the results not being so uniform as those obtained by Weed with hypotonic solutions. A few of the animals showed marked increase in brain bulk, and one dog in particular developed a very striking cerebral hernia (consult Protocols 3 and 4). The increase in brain bulk remained after death though it was greatly lessened if the animal were decapitated while the heart was still beating, indicating that a part of the increase was due to congestion and a part to some more permanent change. It is worthy of note that it was not during gassing but in the recovery or postasphyxial period that the most marked bulging of the brain occurred. This observation may be worth emphasizing that during asphyxia, even when profound and prolonged, the increase in brain bulk was slight. It was after the period of intense asphyxia was over and the animal on the road to recovery that the rise in brain bulk was observed. No explanation of this peculiar chronologic relation is now available.

PROTOCOL 3.—*March 9, 1923. Young Dog. Volume Changes of Brain Observed Through Trephine Opening*

Time	Observation
2:15	Strong CO till unconscious. Tracheotomy.
2:05	Dilute CO.
2:55	Strong CO. Over-breathing and apnea, artificial respiration.
3:10	0.1 per cent. CO. Trephined hole (left temporal) 1.7 mm.
3:25	Dura opened.
4:00	Brain now level with outer table of skull.
4:20	Strong CO. Long period of apnea. Artificial respiration, no response. Artificial respiration and carbon dioxid given.
4:33	Spontaneous respiration. Brain below outer table.
4:40	Brain 1 mm. above outer table. (No more CO given.)
4:45	Brain 1.5 mm. above outer table.
5:00	Brain 2.0 mm. above outer table.
5:15	Brain 2.5 mm. above outer table.
5:30	Brain 3.5 mm. above outer table.
5:45	Brain 4.0 mm. above outer table. Still comatose. Retinal veins definitely fuller than at the start of the experiment.
6:00	Brain 4.5 mm. above skull; lacerated against edges of trephine hole.
6:15	Brain 5.6 mm. above skull.
6:25	Brain 7.8 mm. above skull. More lacerated and bleeding.
6:35	Sudden opisthotonos and paroxysm of dyspnea. Head bent backwards till nose touched back.
6:35	Brain 10 mm. above skull. Spasmodic struggling convulsive in character.
6:43	Attacks of dyspnea (Cheyne-Stokes in type).

7:00 Violent Cheyne-Stokes respiration and clonic convulsions.
7:05 Brain 10-12 mm. above skull.
7:30 Eyes examined by Dr. A. Yudkin. Fundi: veins full and somewhat tortuous; papilla very pale, but no definite edema seen; retina orange instead of normal green.
7:40 Given a few breaths of CO for anesthesia and left external jugular vein dissected out and cannulated.
7:50 to 7:55 Sodium chlorid (30 per cent. solution) intravenously, 30 c.c.
8:15 Twenty-five minutes after salt solution, respiration regular and normal in character, 44 to the minute. Muscles relaxed and tonus normal. No opisthotonos, no convulsions. Whole physical condition has changed from almost moribund state with marked symptoms of cerebral compression to a state almost normal. Brain hernia no longer tense.
8:20 Brain hernia reduced in size and in spite of clot it has shrunken away from skull margin. Fundi: optic papilla now hyperemic; whole retina has changed from a pinkish orange to a greenish fluorescent background. Dog killed. Photos taken at noon next day to show hernia.

The things of chief interest in the experiment of Protocol 3 are the great increase in brain bulk coming on during recovery after intense asphyxia, the remarkable color changes in the eye grounds, the violent symptoms of compression and the sudden marked relief following injection of hypertonic saline solution.

PROTOCOL 4.—*March 20, 1923. Young Cat (Male)*

Time	Observation
10:00	Fundi normal.
10:10	CO till unconscious. Tracheotomy.
10:30 to 10:20	Trephined (left temporal) under CO anesthesia. Fundi: veins dilated.
10:40	Dura opened.
10:42	Fundi: veins much dilated, papillae hyperemic, especially on the left. Eye grounds green.
10:45	Brain below internal table of skull.
11:00	Brain below outer table of skull.
11:30	Brain just level with outer table. Fundi: veins less dilated, otherwise the same.
12:00	Brain as before. Fundi: retina, originally green, becoming yellowish, with narrow green rim remaining at margin of the papilla.
12:40	Brain below outer table. CO stopped. The cat has been unconscious under CO for 2½ hours. Recovery period started.
1:00	Photograph taken. Cat lying quietly with eyes closed. Respiration regular. Brain below internal table. Fundi: less congested.
2:00	Brain below internal table. Fundi: no congestion.
2:45	Brain level now with outer table.
3:15	No change.
3:30	Brain 1 mm. above outer table.
4:00	Brain 2.5 mm. above outer table.
4:45	Brain 3 mm. above outer table. Photographs taken at 4:15 and 4:40.

5:00 Fundi: papillae show hyperemia. Decapitated.

After decapitation the brain still bulges above outer table of skull. On section of brain, sulci proved to be narrowed and the cerebral ventricles collapsed.

Slice of brain fixed in Zenker's fluid; one-half brain fixed in 10 per cent. dilution of liquor formaldehydi.

Protocol 4 shows, though in lesser degree than the previous experiment, the characteristic eye ground changes and the postasphyxial bulging of the brain through the trephine opening, this bulging remaining after decapitation and thorough drainage of the blood from the cerebral vessels.

(b) Effect of Hypertonic Saline Solution Experimentally: Since Weed and McKibben,[14] Cushing and Foley,[16] and others have shown that cerebral volume can be reduced by injection or ingestion of concentrated saline solutions, and that this reduction is due to passage of water from

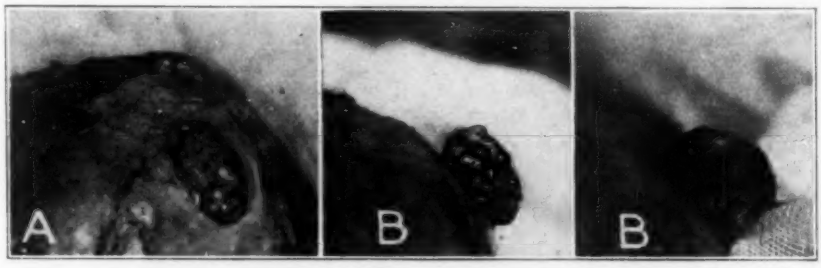

Fig. 5.—Dog of experiment in Protocol 3; skull trephined and dura opened. *A*, normal level of cortex seen through trephine opening; *B*, cerebral hernia (two views) due to postasphyxial increase in brain volume.

the tissues into the blood,[17,18] it was of interest to see what would be the effect of salt on these gassed animals.

Our findings were as follows: (1) Brain bulk was diminished, the first effects being noticeable in about fifteen minutes after the injection (Protocol 3). In this case the salt was given after extreme herniation and laceration had occurred and therefore complete retraction did not take place, but the relief of tension was very marked; (2) retinal congestion was relieved (Protocol 3), showing clearly that pressure within the skull no longer obstructed the venous outflow from the eye; (3) the effect of salt solutions on symptoms in animals and in man. Pressure symptoms in animals were relieved (Protocol 3). In this animal extreme

16. Cushing, H., and Foley, F. B.: Proc. Soc. Exper. Biol. & Med. **17**:217, 1920.

17. Weed. L. H.: Physiol. Rev. **2**:194 (April) 1922.

18. Barach, A. L.; Mason, W., and Jones, B. P.: Arch. Int. Med. **30**:668 (Nov.) 1922.

opisthotonos and violent paroxysms of Cheyne-Stokes respiration were completely relieved within twenty-five minutes after the salt injection.

(c) Histologic Studies of the Brain: In a series of six cats severely gassed for several hours and carefully controlled, no positive evidence of edema was found. The ependymal cells of the choroid plexus in three cases showed swelling, irregularity of outline, and occasional loss of nuclei. In two animals killed by gas and not decapitated, the iter and tissue immediately surrounding was found filled with red blood cells.

(d) Desiccation Experiments: Cats were gassed in a box as in the preceding experiments, but in this case they were gassed till death and not decapitated. No entirely satisfactory controls were obtained, though animals killed quickly by ether or illuminating gas were used for comparison. Sections of brains were weighed accurately and then dried for from two to three weeks at room temperature in a vacuum desiccator over sulphuric acid until a constant weight was reached.

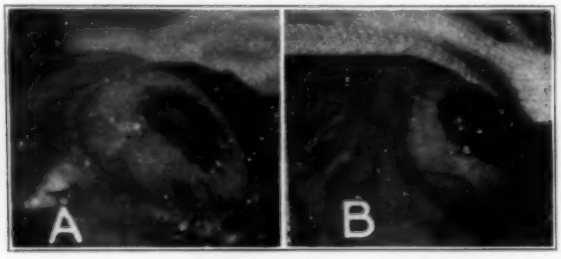

Fig. 6.—Cat of experiment in Protocol 4; skull trephined and dura opened. *A*, at beginning of recovery period after intense asphyxia; level of cortex below inner table of skull; *B*, three hours later; brain bulging 3 mm. above outer table of skull.

The sections, 3-4 mm. thick, were placed on dry filter papers of known weight and quickly weighed. Uniform speed was necessary, for the tissue lost weight rapidly by evaporation. Two sections from each brain were taken. The vacuum in the desiccator was obtained by water suction and the pressure within the chamber was kept at approximately 20 mm. of mercury. The vacuum was tested daily and renewed as necessary. When the sections reached a constant weight they were considered fully desiccated. The dry filter papers were found to lose so little weight that this loss could be neglected and the original weight of the filter deducted. The loss of weight of the brain section was divided by the original weight, giving the percental loss or the percentage of water in the fresh tissue.

Out of a total of twelve or more experiments only five have been used since the others were not carried out with sufficiently uniform technic. The results showed a 3 per cent. difference in water content

between the brains of cats gassed several hours and those killed at once. The carbon monoxid brain in each case showed more water than the control but the difference was hardly beyond experimental error and no definite conclusions seem justified. If, however, a greater percentage of water could be demonstrated with certainty it would indicate edema rather than congestion, for a congestion of equal degree was observed post mortem among the controls. The following protocols give examples of the results obtained by this method:

PROTOCOL 5.—*June 9, 1922. Cat, Half Grown*

June 7 Gassed with CO in box 7½ hours. Stuporous all day. Apparently unable to move left hind leg.

June 8 Gassed with CO in box 6¾ hours. Unconscious most of day. Difficulty in moving hind limbs, but no definite paralysis.

June 9 General weakness but no paralysis. Gassed with CO for 50 minutes. Unconscious.

Necropsy: Lungs—right upper lobe shows marked congestion; Brain—no macroscopic hemorrhages seen. Two sections removed and weighed at once.

	Section 1	Section 2
Weight of fresh brain tissue	1.809	2.040
Weight 17th day dried	0.524	0.604
Weight 21st day dried	0.524	0.604
Water loss	71%	70%
Average	70.5% water in brain.	

PROTOCOL 6.—*June, 14, 1923. Control*

Cat killed by ether	Section 1	Section 2
Weight of fresh brain tissue	1.451	1.703
Weight 12th day dried	0.472	0.543
Weight 16th day dried	0.472	0.543
Water loss	67%	68%
Average	67.5% water in brain	

In order to test this desiccation method in a brain known to be edematous, sections of a freshly removed brain were taken before and after soaking it in distilled water. These sections were desiccated by the usual technic. Though the brain had increased a third or more in size (many times more than would have been possible within the skull) the water content was only 4 per cent. above that of our gassed cases and 7 per cent. above our controls. From these figures it seems possible that a rise above normal of only 3 per cent. in water content of the living brain within the intact skull may be significant.

HUMAN OBSERVATIONS

The importance of observations on man to check the animal experiments is obvious, since in the latter we have no gage of the subjective symptom, headache. Two methods of human observation were available:

first, ophthalmic examination of a subject before and after voluntary gassing; second, record of spinal fluid pressures by lumbar puncture on hospital patients after serious accidental gassing.

Ophthalmoscopic Examination of a Subject Experimentally Gassed.—The subject was allowed to breathe a moderately dilute carbon monoxid mixture until symptoms reached an unpleasant stage, the fundus being examined before and after. The gassing chamber used was designed by Professor Yandell Henderson. It was an air-tight box of thin sheet iron, approximately $4 \times 6.6 \times 8$ feet ($122 \times 201 \times 61$ cm.), reinforced on the inside by wooden two by fours. An electric fan and a hole for admitting gas and for taking samples completed the chamber.

The carbon monoxid was generated in this case, as in the animal experiments, from formic and sulphuric acids heated together in a water bath. The gas was passed through potassium hydroxid solution and collected in a Douglas bag. The percentage was determined by analysis in an Orsat apparatus.

After one-half hour of exposure to carbon monoxid, definite dilatation of the retinal veins and hyperemia of the papilla were observed. The headache came on during the recovery period and was at its worst when the fundus showed the maximum changes. Indeed, both experimental and clinical data have shown that the headache is postasphyxial. This was noticed in 1895 by Haldane in human experiments,[19] and it is of especial interest on account of our observation that the increase in brain volume occurred almost entirely after the period of asphyxia was over. The following protocol gives the details of the human experiment.

PROTOCOL 7.—*March 29, 1923. Congestion in Human Retina.*

Man, Healthy Adult

Time	Observation
1:30	Just before the gas chamber was entered by the subject, an ophthalmologist, Dr. A. Yudkin of New Haven, made a careful examination of the fundus. Pupil 4.5 mm. No congestion present. Color of optic papilla and caliber of vessels noted.
1:34	Gas on. Twenty parts CO to 10,000 of air (0.2 per cent.).
1:39	Sitting. Pulse 74.
2:09	Sitting. Pulse 120. Feeling dizzy, sick, and weak. Vision distinctly dimmed; sense of fulness in head; no real headache. Great effort to write or move at all.
2:09½	Out of gas. Total gassing, 35 minutes. Tannic acid test for CO hemoglobin, 40 per cent. saturation.
2:17	Fundus examination by Dr. Yudkin. "The nerve outline is slightly blurred, and the papilla is more hyperemic than before gassing. The veins are engorged but not tortuous. Pupil, 7 mm."
2:19	Definite headache beginning.

19. Haldane, J.: Jour. Physiol. **18**:440, 1895.

2:35 One half hour out of gas. Sitting. Pulse 90. Headache slightly increased, dizziness less, pulsation in head less. Feeling much better, except for headache. Fundus examination: optic papilla is more hyperemic than at last note; blood vessels same caliber.
2:50 Fundus: no change. Headache same.
3:00 Drank 10 c.c. of 30 per cent. sodium chlorid solution (3 gm.).
3:30 Feeling much better. Headache less.
3:35 Drank 8 c.c. of 10 per cent sodium chlorid solution (0.8 gm.).
3:45 Headache is practically gone.
4:05 Fundus: no change since last note.
6:00 Headache increased after walking in cold air. Head still hurts if shaken and eye ball is slightly painful if turned far over to one side.
Headache lasted till sleep. Next morning it was gone.

A Case of Poisoning by Illuminating Gas.—This case report is introduced to show two things: a high cerebrospinal fluid pressure due to carbon monoxid asphyxia in man, and the clinical effect on the patient of hypertonic saline solution. It may be well to state here that illuminating gas is for our purposes the same as pure carbon monoxid. Although the former gas contains small quantities of other toxic substances, the sudden effects on cerebrospinal fluid pressure, etc., with which we are dealing, are entirely due to asphyxia from the carbon monoxid.

REPORT OF A CASE

A man, aged 25 years, previously healthy, was overcome by two to three hours' exposure to illuminating gas from a leaky gas heater, and was taken to the Boston City Hospital. When seen half an hour after removal from the gas he was unconscious, breathing deeply, skin noticeably pink, and with a fibrillary tremor of pectoral muscles with respiration. Ophthalmoscopic examination: optic disks clearly outlined; retinal veins appear to be dilated, but the normal for this individual is not known. Two hours later, still unconscious, pulse 134, respirations 19, blood pressure 75 systolic, 55 diastolic. Lumbar puncture: spinal fluid pressure 21 mm. of mercury; the normal is approximately 10 mm. with a range of from 8 to 15 mm. Fifty cubic centimeters of spinal fluid was withdrawn during a period of twenty minutes, reducing the fluid pressure to 10 mm. The patient became more active and restless at the end of the puncture. Pulse 128, respiration 18, blood pressure 80 systolic, 60 diastolic, immediately after the puncture.

Twenty-two hours later: the patient was still stuporous, could be aroused with difficulty and was then irritable and complained of headache. Pulse 89, respiration 25, blood pressure 125 systolic, 85 diastolic. Right knee jerk and arm jerk greater than left. Lumbar puncture: spinal fluid pressure 19 mm.; no fluid removed. One hundred cubic centimeters of 15 per cent. sodium chlorid solution given intravenously during a period of eighteen minutes. Immediately after this hypertonic injection, the patient became clearer mentally and stated that his headache, which had been severe, had entirely disappeared. He responded readily to questions. During the next few hours improvement continued, and after three or four hours he sat up and took nourishment. Next day all reflexes were equal and active; blood pressure was 155 systolic,

70 diastolic. The patient was kept under observation for eight days in the hospital and was then discharged as recovered. One month later he reported "well."

During the latter part of the saline injection the patient's face became slightly flushed, and he had a slight chill ten minutes after the salt was given. Otherwise no complication arose during or after the injection.

In this case the relief following injection of hypertonic saline solution was immediate and lasting, whereas the relief after simple withdrawal of cerebrospinal fluid twenty-two hours previously had been slight and only temporary. If edema of the brain was indeed present in this case, the withdrawal of fluid from the brain tissue by the blood through the agency of a hypertonic solution would seem to have been the logical procedure.

SUMMARY

Carbon monoxid inhalation was found to cause in animals and in man a rise in intracranial pressure. Three conditions were considered which might explain this rise: cerebral congestion, increased secretion of cerebrospinal fluid, and cerebral edema. Cerebral congestion was the first observed and to it were due the sudden rises in pressure recorded by manometer. Of increased secretion of fluid, no evidence was found, though our experiments did not rule it out as a possibility. In regard to cerebral edema, definite evidence in favor of its occurrence was obtained. This evidence consisted chiefly in the following observations:

After prolonged asphyxia a gradual increase in brain bulk was observed through a trephine opening.

This increase persisted after decapitation of the trephined animal. It was therefore a true increase in volume and not due to dilated ventricles distended by fluid, or to vascular congestion.

Intravenous injection of hypertonic saline solution, which was known to cause absorption of water by the blood from the tissues, reduced the increased brain bulk and relieved compression symptoms.

In man, intravenous injection of hypertonic saline solution relieved promptly a stuporous condition, accompanied by an abnormally high spinal fluid pressure and headache, of twenty-four hours' duration, due to asphyxia by illuminating gas.

Histologic study of gassed animals showed no typical picture of cerebral edema. Desiccation experiments suggested the presence of slight edema but were not conclusive.

In animals the early increase in intracranial pressure was accompanied by a dilatation of the veins about the optic papilla, and the late increase in brain bulk was accompanied by a striking color change in the fundus from green to orange, due probably to congestion of the smaller vessels of the choroid.

In man the headache following experimental gassing was at its height half an hour after removal from the gas and at this time dilatation of the retinal veins and hyperemia of the papilla were at their maximum.

CONCLUSIONS

Carbon monoxid asphyxia causes a rise in intracranial pressure.

This rise shows two distinct elevations; the first occurs during asphyxia and is caused by congestion due to a rise in arterial pressure; the second occurs after asphyxia and is caused probably by edema.

The intracranial pressure is of sufficient height to produce transient eye ground changes observable by ophthalmoscope.

In animals, postasphyxial symptoms of cerebral compression are relieved by the administration of hypertonic saline solution, which reduces brain bulk.

In one clinical case a high spinal fluid pressure was present, accompanied by stupor and severe headache. Immediate relief from symptoms followed an intravenous injection of hypertonic saline solution in this case.

Finally, it may be said that the carbon monoxid headache is closely associated with, if not directly caused by, an increased intracranial pressure due to congestion and possibly also to edema.

PHYSIOLOGIC CONDITIONS UNDER WHICH INSANITY OCCURS *

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PHILADELPHIA

In the study of the varieties of insanity, it is difficult to see any action on the part of the organism indicative of a mobilization of its physiologic forces tending toward a spontaneous recovery. There is no leukocytosis, no vomiting to evacuate a poison, no rapid pulse to overcome the effects of the inroad of disease. Nor is there seen the compensatory action observable in other forms of disease. There seems to be established a vicious physiologic circle and I shall endeavor to show that there are "physiologic patterns" evidenced by the response of the involuntary nervous system, and that these have correspondence with mental patterns so that there can be differentiated certain nervous mechanisms in the various psychoses which, taken together, form an approach for the application of the principles of general medicine to the psychoses.

Just as the psychoses fall into several groups or patterns, such as depression, excitement, phobias, etc., in like manner each of these groups from the pathologic viewpoint, according to our studies, follows a certain pattern.

In the psychopathic wards of a large general hospital, in which are placed all patients with mental disorder, regardless of whatever else may be wrong, as this great mass is observed there develops in the mind of the alienist a simplified classification, and by experience it would seem that the patients can be divided into four classes: (1) those who have been definitely insane for some time—the chronic cases; (2) those who are affected by syphilis, or chronic alcoholism; (3) those whose circulatory systems are worn out—the cardiorenal cases; (4) those undifferentiated persons who are sick with something, we do not know what, and who show mental symptoms. These are the acute cases.

It is easy to deal with the first, or chronic, group—they go to the insane department. The syphilitics and alcoholics are also easily disposed of—they include the general paralytics; while the third or senile group is also removed, leaving only the acutely sick to work with. If we cannot do something for this group with acute cases, they will soon begin to show well defined symptoms of certain mental patterns,

* Read at the Forty-Ninth Annual Meeting of the American Neurological Association, Boston, May 31-June 2, 1923.

such as the hebephrenic and catatonic, with just a little more progress of the pathologic condition that is going on somewhere within them. It is this pathology that we must endeavor to discover.

In the incipiency of these cases we are impressed with the almost constant fact of the "hallucinatory explosion" of the disease. It presents different characteristics in succession as it goes on, and there develops one sort of fixed state or another, such as hebephrenia or catatonia, and the hallucinatory state is then only one element in the picture.

In going about the wards it becomes more and more evident that the group with whom we are to work is made up simply of sick people, bilious in appearance and delirious in mind, and that the method of approach must be somatic. The methods of general medicine as practiced in most hospitals do not bring out the essential differences, and it is the purpose of this paper to present such things as, taken together, might be called "the theory of the psychiatric internist." The argument is, as has been said, that there can be observed variations in the separate parts of the involuntary nervous system, parts that preside over different functions, so that there can be seen a physiologic pattern corresponding to the type of mental disorder, and causative factors can then be sought, having in mind those portions of the involuntary nervous system that are changed in tone, using observations of smooth muscle function as the index.

Following Gaskell, there are three outflows of involuntary nervous elements, with motor and inhibitory functions controlling all the smooth muscles of the body. They are: (1) thoracicolumbar (sympathetic); (2) midbrain (third nerve); (3) bulbosacral (vagus system—vagus nerve and pelvic nerve).

The integrative action of these different functioning parts can be observed in numerous ways. In this group of cases we used the three physiologic symptoms that are easy to demonstrate, one for each outflow: (1) blood pressure variation (sympathetic); (2) pupillary variation—dilatation and contraction (third nerve and cervical sympathetic); (3) peristalsis, by roentgen-ray pictures of the intestines (tenth nerve and pelvic vagus). This gives physiologic information from all three outflows of the involuntary nervous system, which are charted below. Many more symptoms with this innervation can be correlated as the matter is better understood, such as red hands, sweaty skin, etc.

In the first diagram of Chart 1 there is a spastic transverse colon, sigmoid and rectum. This is the innervation of the pelvic vagus. In the second illustration is shown a colon with no motion at all, the only evidence being sympathetic inhibition. The third illustration is one with extreme hypermotility, so that the bowel works perfectly, but many times as fast as it should. This is caused by both the vagus and sympathetic. Barium taken at night will be gone in the morning.

Illustration four shows the colon of that individual called the "vagotonic." There is seen ptosis of the bowel, and the stomach low down in the pelvis, all of the symptoms being those of extreme activity of the vagus system, and very little of the sympathetic. Illustration five shows an abnormality in the shape of a "V" colon, which increases the resistance to the passage of the contents.

The explanation of the normal automatic responses of the involuntary nerves lies in the working of appropriate arrangements which are already perfected in our nervous systems at birth, and this arrangement provides for what are known as "pattern responses" or, sometimes, "conditional reflexes."

The foregoing diagrams of the physiologic changes in the colon in the insanities show that they can be reasonably interpreted as a part

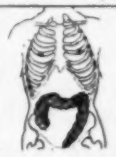
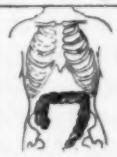
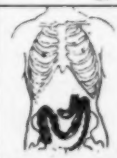
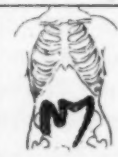
Groups	1 9%	2 7%	3 13%	4 27%	5 4%
Pelvic Geography					
Blood Pressure	Moderate	High	High	Low	Low
Pupillary Conditions	Contracted	Greatly Dilated	Dilated	Contracted	Contracted
Urinalysis shows	Albumin (trace)	Acetone Diacetic Acid Indican Albumin (trace)	Nothing	Indican-(Quantity) Albumin-(trace)	
Feces Analysis shows	Mucus Gram positive bacilli	Bowel contents only are infected	Nothing	Mucus Gram positive bacilli	
Mental Characteristic	Confusion Dementia	Confusion	Manic	Depression	Depression

CHART 1

of nonmobilization of the resources of the organism, and it is noticeable that the pattern responses in the neuromuscular mechanism of the bowel are not those described by Cannon as occurring in states of fear, anger or deep anxiety, which might be construed to mean that we are not dealing with psychogenic origins acting on the viscera and hence generating vicious circles, but that we are dealing with trophic substances having special effect on the pelvic vagus or any other part of the involuntary nervous system. However, one group (Column 2) is quite like that which Cannon describes in his experimental work, and the histories in this group in a way confirm the theory of the psychogenic origin in certain disorders.

The patterns in the diagrams of the neuromuscular mechanism of the bowels should be correlated with the blood pressures that are observed.

In the first group the blood pressure is moderate, while in the second and third groups it will be high. In the fourth group the pressure will be found low. These variations are somewhat dependent on the degree of intoxication of the patient.

Then also should be correlated the pupillary conditions. In the first group the pupil will be contracted. In the second group it will be enormously dilated. Dilatation is also found in group three, but not to the extent found in group two. In the fourth group, the pupils will be found to be contracted. Physiologic variations of this sort may be quite definitely observed, as in other fields, and symptoms may be added as they are better understood.

With each group there is a corresponding mental state. In the first is found stupidity, as of dementia praecox. This classification should not be used, however, until there is absolutely no doubt, as the second group looks very much like it mentally, though physiologically it is very different. Group three is manic. All the cases I have observed in this group give the same physiologic picture. While the first two groups might be called "confusions" and the third "manic," the fourth group is differentiated by "depression."

Examination of the urine shows some differentiating factors, as we find in group one only a trace of albumin; in group two we find acetone, diacetic acid, indican and a trace of albumin in the acute stage. Group three is apt to show nothing, while the fourth group will always give a large quantity of indican along with a trace of albumin. Almost any mental case will give some albumin, just as it is found in toxic and fever cases, but discussion of the urine will be more thoroughly taken up at another time.

Examination of the stool is mentioned only briefly. In the first group, because of usual inflammation of the mucous membrane of the bowel, there is found mucus and a predominance of gram-positive organisms. As the patient improves the stool symptoms disappear. In the second group there is no infection of the mucous membrane, but the infection is in the bowel contents. In the manics (Column 3) there is nothing yet to be described. They have an excellent digestion and they are physically healthier than the average. Patients will come through a manic explosion and not show any serious effects of it. In the fourth group there is very often a marked colitis, so there will be found certain evidences in the stool, such as mucus and gram-positive bacilli, etc.

The cases in group one may be called the worst to handle, because they become demented, and this condition occurs because it is not known what substance is exercising the trophic influence on the pelvic vagus. The cases in group two will not become demented if treated early enough. The hyperactive cases, group three, get well, but it is not

known why. In the fourth group there is usually an infection in the bowel, and in group five, when the individuals are not degenerate in physique, they improve when the extra resistance and its results are alleviated.

We are trying to illustrate that there is a physiologic mechanism of insanity, and therefore a disorder of physiologic mobilization with products which result from such disorganization of the smooth muscle as we have been able to demonstrate. There is undoubtedly more that could be determined, but here is a method of approach, so that psychiatry can be studied as any other part of general medicine. As to how the vicious circle in physiology is instituted, we can only say that it may be of reflex origin, as in infection of the tubes, or by systemic origin, as in tuberculosis. The point of view which is taken of diseases of the digestive system by Foster in his "Examination of Patients" is also directly applicable to the nervous system, and it is here given, with two columns added—the "lesion type" and the "reaction type," names suggested by Adolf Meyer's classification.

Reaction Type		Lesion Type
General Paralysis. Senility.	Organic	Tumors. Syphilis. Sclerosis
Delirium, Hallucination and Affective Disorders. Elation. Anxiety. Depression. Delirium	Reflex	Appendix. Gallbladder. Focal Infection. Colitis
	Systemic Diseases	Tuberculosis. Nephritis. Cardiac Disease. Lime Deficiency. Thyroid Deficiency.
Paranoia. Hysteria. Delinquencies	Functional (constitutional inferiority)	Teratologic

CHART II

We have made an intensive study of one hundred cases, each one in order as admitted, and the percentages on the chart are made on that basis. The cases making up the remainder of the percentage were organic and constitutional cases and do not appear in the chart. Below are presented illustrative case reports, one from each group as presented in our chart.

REPORT OF CASES

Group 1.—G. S., a man, aged 18, was admitted to the hospital, grinning, exhibiting mannerisms, and with a history of impulsive actions. He had been sick only a few weeks, but gave a distinct impression of dementia praecox. Indican was always present in the urine. Stained preparations of the stool presented a great predominance of gram-positive organisms, mainly diplococci. The proctoscopic examination gave evidence of a diffuse congestion but no inflammation of the mucous membrane of the bowel.

Barium, for fluroscopic examination, rapidly passed until it reached the hepatic flexure. From that point it advanced extremely slowly, the cecum began to dilate, and for fifty hours there was only a slow advance of the barium toward the outlet. There was evidenced no inhibitory action of the sympathetic, but there was a motor overactivity of the vagus system. This overtone of the

vagus, particularly of the pelvic nerve, with evidence of toxemia, and a bowel with no ptosis or deformities, together with a nonvagotonic morphology, suggested a focal origin. When this boy died, as the result of an accident, there was evidence of subinfection in the colon, round cell infiltration of mucosa, and vessel walls infiltrated with leukocytes.

Microscopic Examination of the Colon.—The mucosa was generally thin, with many endothelial and eosinophil cells; the endothelial types were found in large masses. The lymph nodes were hyperplastic; there was round cell infiltration of the mucosa. The blood vessels of the submucosal glands were dilated. One area showed hyaline degeneration. The submucosa was very cellular; the walls were thickened, and infiltrated with leukocytes; the mocous glands were distended; the blood vessels throughout were dilated; the muscular coats were atrophied; the colon was atrophic. The mesenteric glands were very cellular; there was some little thickening and tendency toward fibrous changes; some showed considerable hyperemia. In our experience this type may have its origin in impacted teeth or an appendix or other focus of infection, or possibly in infection of the colon itself.

Group 2.—H. S., a boy, aged 15, was brought to us because he thought detectives were after him. A month before he had written home saying "I have been worried about the wrong things, not able to concentrate on lessons. I have not trusted anyone. I have been brooding, etc." He had the persecutory trends of dementia praecox. This boy stood before us, dumb and stupid looking, and urinated on the floor while standing for examination.

His pupils were very slow in reacting to light and widely dilated, and his hands were red and cyanotic. His breathing was shallow, pulse rapid and the urine contained some indican and a trace of albumin and often acetone. His stools were putrid, with enormous numbers of gram-positive cocci, and many fields showed these organisms in clusters or islands. The gram-negative bacilli were few.

Barium introduced into the stomach stayed there for hours, the stomach being atonic and distended with gas. Travel through the small intestine was very slow, and the same sympatheticotonic inhibition was observed throughout this tract. This boy showed the activity of the sympathetic side of the vegetative nervous system particularly prominently, the dilated pupils and periastaltic inhibitions. The blood pressure was low because of a toxic vasodepressant circulating in the blood, emanating from the static bowel. This case contrasts with the vegetative neurology of the one previously described.

Treatment.—Vaccines, autogenous from the feces, irrigations and pressor internal secretions were used. Members of this group made excellent recoveries and in a clinical way we consider them of the variety in which a toxemia is generated by infection of the fecal contents. It is possible that such cases may have a psychogenic origin—fear with sympathetic inhibition, but, whatever the origin, the roentgen rays and stool examinations show a method of clinical medical approach.

Group 3.—The manic-depressive cases show overaction of both systems. The manics, of whom in this study we have recorded thirteen cases, were of special interest to us because of the great increase in peristalsis. We were not able to demonstrate any toxic origins. They were the only cases in which the bowels were in proper anatomic position, not ptosed, nor with any other sign of degeneration.

Most of the other types of cases did show morphologic stigmas of degeneration, but the manics were quite normal as to blood, urine, and feces, as far as our investigations were carried. They did show great increase in peristalsis.

Barium given in the evening would be expelled in the morning. It was neither the vagus nor the sympathetic predominating, for the relaxation was perfect and the motor action was flawless, but each one came into action with a greatly increased speed. If all the other physiologic acts under the domination of the vegetative nervous system are performed in the same manner, it is understandable why the manic keeps in such good physical condition. In fear or rage there is nothing physiologically analogous, for the reaction of these emotional states is a purely sympathetic action.

Group 4.—This is the group with predominance of the whole vagus system. Twenty-seven per cent. of the cases in this hundred were those with the mental symptoms of unworthiness, fear and inadequacy. They were of the morphologic type of asthenia, with narrow, long bodies and short extremities, and with all abdominal organs down in the pelvis, low blood pressure and small pupils, quite vagotonic. Roentgen-ray examination always brought out the ptosis of the stomach and bowel, usually a spastic bowel, and in the spastic large bowel there were signs of colitis, and irrigation would demonstrate mucus and other signs.

Many cases of this variety have shown no improvement, but others, when it was possible to demonstrate the organisms responsible for the colitis, made good recoveries. For example: one who was infected with pyocyaneous recovered with acetic acid irrigations, and another, with intensely gram-positive organisms, made a satisfactory recovery with vaccine and irrigation. And the others who improved and recovered were all worked out in a medical way.

This type suffers from an inadequate action of the sympathetic part of the vegetative nervous system, and a predominance of the vagus activity. The physiologic disadvantage of this unbalance is quite patent. But help can be given by a diligent search for foci of infection and a supporting physiologic treatment by endocrines of chromaffin variety, and by ptosis belts, fattening, etc. The medical problem is on quite a different basis from that in the cases in which there are sympathetic inhibitions, or those with pelvic spasms.

Group 5.—Psychotic cases with intestinal abnormalities. Four of our cases, which are nondescript in their mental symptoms, perhaps would be called psychotic. They had intestinal abnormalities which were clearly shown by the roentgen-ray; that is, they showed what may be termed "V" colon loops extending down from the transverse colon where the hepatic flexure usually ascends. These patients seemed to be suffering from toxemia generated as a result of the extra resistance to the passage of the intestinal contents and the consequent delay. One of these cases made a perfect recovery by relief of this resistance and by attention to elimination. There was a seventy-two hour retention. In none of these was there a definite infection, but I cannot see why cases might not occur in which the stasis might lead to the development of infection in the tract.

In this series there were only two true melancholics. One of them was of interest because of the roentgenograms, which showed a hyperstimulation of the pelvic vagus nerve, quite as was seen in the case first described, of the dementia praecox variety. The mental phenomena in this case, of a woman aged 50, were quite similar to a depressed dementia praecox and the case suggests the thought, expressed before, that mental disorder of different periods of life may have the same integration—vegetative pattern, the observed difference in mental phenomena being due to the age at which this action is applied, and to the nature of the exciting factor.

Psychogenic origins are quite possible, such as continued fear stimulating the sympathetic, as in the second case described, and there setting up a vicious circle of stasis, fecal infection, etc. I can also conceive of impacted teeth, or eye strain, originating by reflex, setting up a vicious circle of perverted physiology through the effect on the neuromuscular mechanism of the bowel. Fecal infection also can set up a vicious circle.

The method of treatment in every instance, regardless of what the origin may be, is to break the vicious circle at any point possible, and an attackable point to begin at is in the bowel, where the results, if not the origin, can be seen in the neuromuscular mechanism and from a study of the bowel content. The cases must be handled early to get the value of this method of diagnosis, as long demented material has not the same possibilities.

About a year ago I examined a child of seven, born of high strung parents, and they themselves coming from nervous stock. The child was examined out of curiosity—not because she was sick. Her colon was very much ptosed, but she was well, with good color and strength. She was apt to be constipated. Recently she developed a colitis and was very sick, running a high temperature and having delirium. This was caused by middle ear inflammation, both ear drums needing puncture. As soon as this was done the temperature fell and the delirium ceased, but she continued to talk incessantly, repeating verses and rhymes. This gradually ceased as she reached convalescence. This was a miniature toxic insanity. The child's nervous system was susceptible to toxins and fever. The ptosis was an internal stigma of degeneration such as we often find in older people susceptible to nervous toxins.

This child exemplifies what we see in adults who go insane. A child has a susceptible nervous system, in addition to a stigma like a ptosed colon, he gets a colitis with extension of the infection to the ears, has a delirium, a puncture which induces reduction of temperature, but has also a continuation of manic talk, flight of ideas and then recovery. I repeat that we have a perfect miniature of the insanity we so often see in adults.

The condition of the neuromuscular mechanism of the intestinal tract has given us more information so far, concerning the nutritive condition and the disorder, than has the blood chemistry, galvanometric studies, or other methods of attacking the problem of the insane, and brings us round to a point of view where general medicine can be applied intelligently.

SUMMARY

1. There is no special pathology nor a specific etiologic factor in insanity.

2. The determining cause may be any type of irritant, such as bacterial or metabolic disturbances, sufficient to upset the physiologic equilibrium of the vagus or sympathetic nervous system.

3. The removal of the irritant or the correction of the physiology or anatomy will tend to restore the equilibrium.

4. The vast majority of the cases are primarily somatic, the mental symptoms obscuring the origin of the somatic lesion.

5. The prognosis is in *direct proportion* to the amount of the secondary changes in the nervous system induced by the primary focal lesion and the background.

6. Each mental case is purely somatic, and should be treated as such. The cause should be remedied and the problem symptomatically met by severing any of the links in the vicious circle established by the primary lesion, no matter where it may be.

DISCUSSION

Dr. Walter Timme, New York: Those of us who examine the vegetative nervous systems in a routine way must reach the conclusion that practically all human beings belong in one of the six types indicated by Dr. Ludlum. It is striking to note that the symptomatology in each group, apart from the actual vegetative nervous disturbance, is quite variable. Certain individuals who belong to the type of low blood pressure (known as the vagotonic type), do not always have psychotic symptoms, but usually have symptoms that are referable to the various fatigue syndromes. It is noteworthy that frequently the tone of the sympathetic nervous system can be improved by various means and methods without improving the psychotic symptoms at all. Dr. Ludlum has outlined methods whereby the psychosis and psychotic symptoms have been improved, but he has not told us whether the tone of the vegetative nervous system was improved. The two conditions, while related, can hardly be cause and effect. If that were not so, as he has correctly stated about the boys in one particular school, we would all be potential lunatics. Perhaps we are, but we certainly have within us some mechanism that compensates for the vegetative nervous disturbance without influencing to a measurable degree the psychotic or neurotic symptoms.

Dr. D. J. McCarthy, Philadelphia: About four or five years ago, Dr. Schwab pointed out the potential dementia praecox content of the normal adolescent mind, and showed that practically all the individual symptoms of the fully developed dementia praecox patient were present, in a mild or latent state, in the adolescent boy; that as he goes through the period of adolescence there are a certain varying moody tendency and other manifestations such as are present in dementia praecox, and yet after passing through adolescence this boy develops into a relatively normal individual. When disturbing factors are present, whether physical, vegetative or bacteriologic, there is a certain tendency to accentuate those characteristics. In working out and dealing with this problem, this assumption offers the most satisfactory line of adjustment. When psychogenic factors are present, they often determine the transition from normal fatigue to a pathologic condition. We must look to the physiologic, as well as the psychogenic factors, if we wish to bring about an adjustment in these adolescent cases and to cut down the number of adolescent disturbances which may go over into dementia praecox.

Dr. Ludlum, in closing: I do not believe that it is possible to differentiate between the different kinds of people. I think that there are psychogenic fac-

tors at work; but there are probably many people who, even though they developed certain illnesses or had their physiology disturbed, would still be sufficiently nonpsychotic to remain normal. I want to accentuate that this is a medical method of approach. Do not remove all colons or simply give thyroid extract, but have the case studied by a clinician.

INCREASED CRANIAL VASCULARITY IN ITS RELATION TO INTRACRANIAL DISEASE

WITH SPECIAL REFERENCE TO ENLARGEMENT OF THE VEINS OF THE DIPLOE AND ITS RELATION TO THE ENDOTHELIOMAS*

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Roentgenograms of the skull present many variations in the size and number of the vascular markings. The venous sinuses, the meningeal vessels and the veins of the diploe may all be visible as more or less distinct dark lines, and needless to say, the better the roentgenogram the clearer the vascular markings are visible. When the calvarium is thin—and this is a point worth noting—the normal vascular channels will often be seen so much better than when the skull is thick, that they may be mistaken for enlargements.

The grooves due to the large venous sinuses—especially in thin skulls and in those of children—are often very shallow and not clearly defined in the radiogram, but when the markings of the superior longitudinal and of the lateral sinuses are distinct, they are easily recognized from their location and size.

The grooves for the meningeal vessels are frequently visible as fine branching lines, from 1 to 2 mm. in breadth, which are in the location and run in the direction of the meningeal arteries and their branches. In stereoscopic roentgen-ray plates, these meningeal markings are usually seen equally well on both sides of the skull, although it is not rare to find slight variations in the size and course of the vessel channels between the two sides.

The diploic veins (the veins of Brechet) lie in the cancellous tissue between the outer and inner tables of the cranial bones and the markings due to them are often visible. The main venous channels are, according to most authors, four in number (Fig. 1):

1. The frontal diploic vein, which drains the anterior part of the frontal bone and empties into the supraorbital or ophthalmic vein or into the superior longitudinal sinus. In about one-third of the roentgenograms of normal skulls, the markings due to this vessel are seen as a system of fine radiating lines less than one millimeter in breadth in the frontal bones of each side.

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*From the clinics and the roentgen-ray department of the New York Neurological Institute.

*Read at the Forty-Ninth Annual Meeting of the American Neurological Association, Boston, June, 1923.

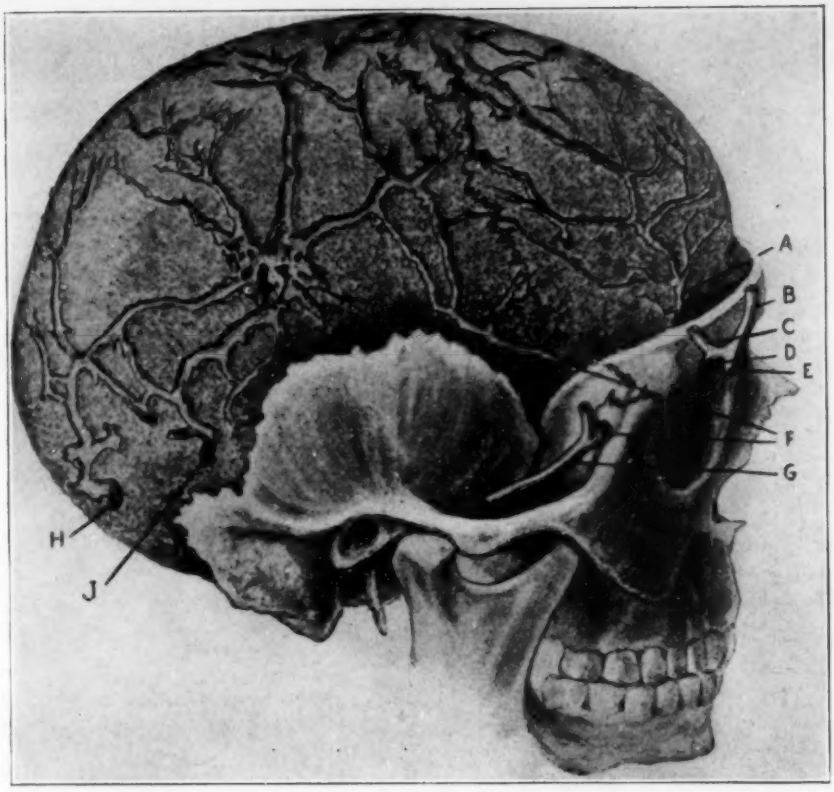

Fig. 1.—The diploic veins (from Piersol's Anatomy). *A*, anterior or frontal diploic vein; *B*, frontal vein; *C*, supra-orbital vein; *D*, frontal diploic vein; *E*, angular vein; *F*, anterior temporal diploic vein; *G*, deep temporal vein; *H*, occipital diploic vein; *J*, posterior temporal diploic vein.

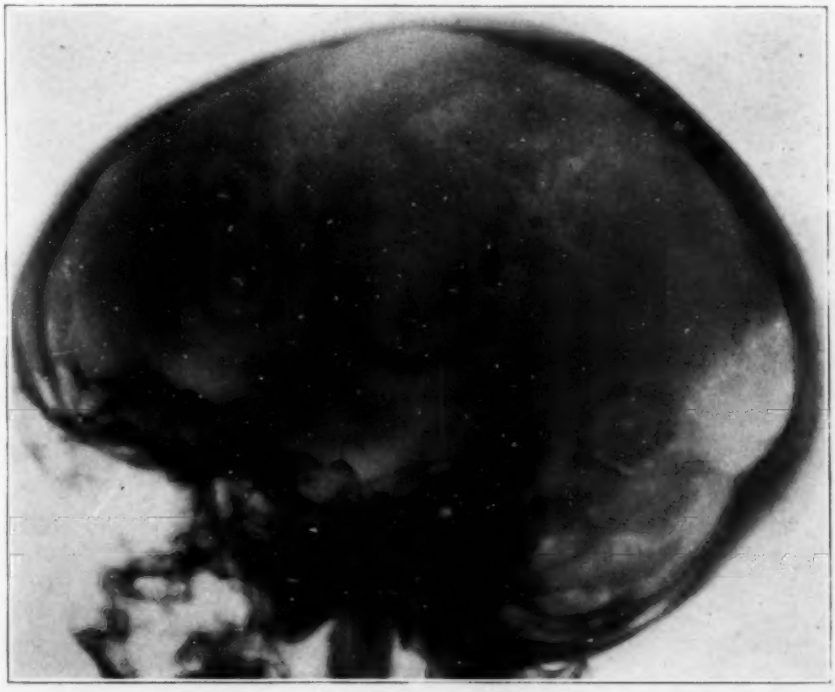

Fig. 2.—Roentgenogram of the skull to show the posterior temporal diploic vein and its branches; a picture frequently seen on roentgen-ray plates.

2. The anterior temporal diploic vein runs in the diploe of the anterior portion of the parietal bone; it drains the posterior part of the frontal and adjacent parts of the parietal and temporal bones, and empties into the sphenoparietal sinus or into the deep temporal vein. The markings due to this vessel are clearly visible in about 10 per cent. of roentgen-ray plates of the normal skull.

3. The posterior temporal diploic vein drains the posterior part of the parietal and temporal bones and discharges its contents into the mastoid emissary vein or directly into the lateral sinus. This system of veins is often visible in roentgenograms of normal skulls as a series of radiating lines, one to two millimeters wide, which usually has a ganglion cell-like appearance (Fig. 2).

4. The occipital diploic vein runs in the cancellous tissue of the occipital bone and terminates either in the lateral sinus or in a large occipital vein.

These diploic veins communicate with each other and with the meningeal veins and venous channels on the outside of the bony skull by means of branches which perforate the inner or outer table of the cranial bones. Branches of these veins often empty into the lacunae and the spaces in which lie the pacchionian granulations.

We have, for a number of years, paid especial attention to the roentgen-ray evidence of these diploic veins, and the present study is an attempt to arrive at a conclusion regarding the significance of the variations in the markings due to these vascular channels.

In the attempt to arrive at a conclusion as to what is normal and what is pathologic, the personal equation of the examiner must play an important part. The roentgenologist, so frequently without a knowledge of the neurologic problems in the individual case, cannot be expected to correlate finer roentgen-ray changes with clinical symptoms. It is a weakness in roentgen-ray diagnosis, and one which will surely be overcome in the future, that roentgen-ray interpretation in a general hospital is so often left to the roentgenologist who is too busy with roentgenograms of bones, of the gastro-intestinal tract, of the chest, etc., to devote the necessary time and study to the neurologic significance of changes he observes on his films or plates. Probably, if he could be supplied with more clinical data, he would be in a better and fairer position to give a comprehensive report.

Obviously, one must have a knowledge of the appearance of the normal skull in order to appreciate finer variations. A study of the vascular markings seen on roentgenograms of the skull, from the viewpoint of what is normal, and from what should occur when the cranial and intracranial venous circulation is interfered with either locally or generally, should yield facts of interest. If such facts could be correlated with the symptoms and signs of intracranial disease and with the

lesions found at operation or necropsy, abnormalities in the size and number of the vascular channels should gain diagnostic importance. Schüller, Heuer and Dandy, and a few others have mentioned the fact that roentgen-ray evidence of enlargement of the vascular channels in the cranial bones was of diagnostic importance, but their publications did not go into detail nor did they study the separate vessels.

Venous Sinuses.—Divergence from the normal in the size of the large venous sinuses is very rarely to be seen, and our roentgenograms did not give us any information as to changes in these vascular channels.

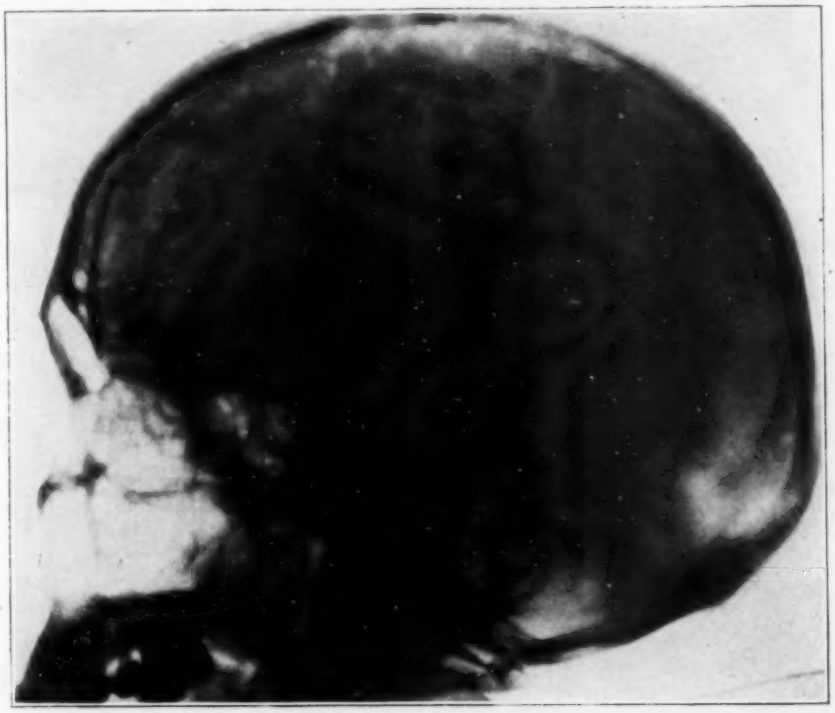

Fig. 3.—Roentgenogram of the skull of a patient with cerebral thrombosis and a large mass of veins on the cortex of the brain.

Meningeal and Cerebral Vessels.—The marking of the meningeal vessels and their branches are subject to many variations, so that we have been unable to arrive at any conclusion regarding the significance —if there be any—of the increased or diminished visibility of the markings. Occasionally a cortical blood vessel, which has become enlarged as the result of cerebral thrombosis or as part of an aneurysmal varix, causes a gradual absorption of the bone of the inner table of the skull which becomes evident on the roentgen-ray plate (Fig. 3).

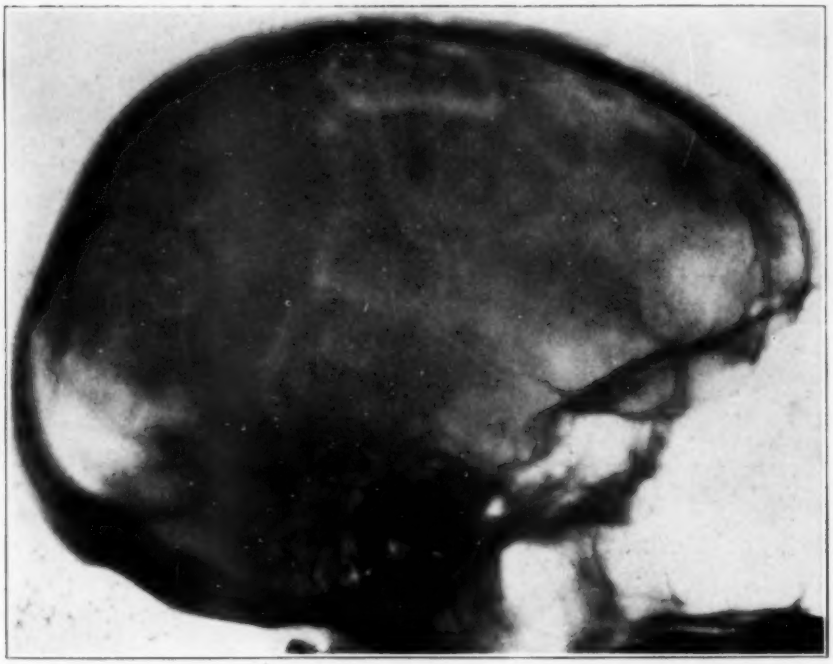

Fig. 4.—Roentgenogram of the skull of a patient with supposed involution melancholia. There is a large posterior temporal diploic channel on the right, and normal skull markings on the left.

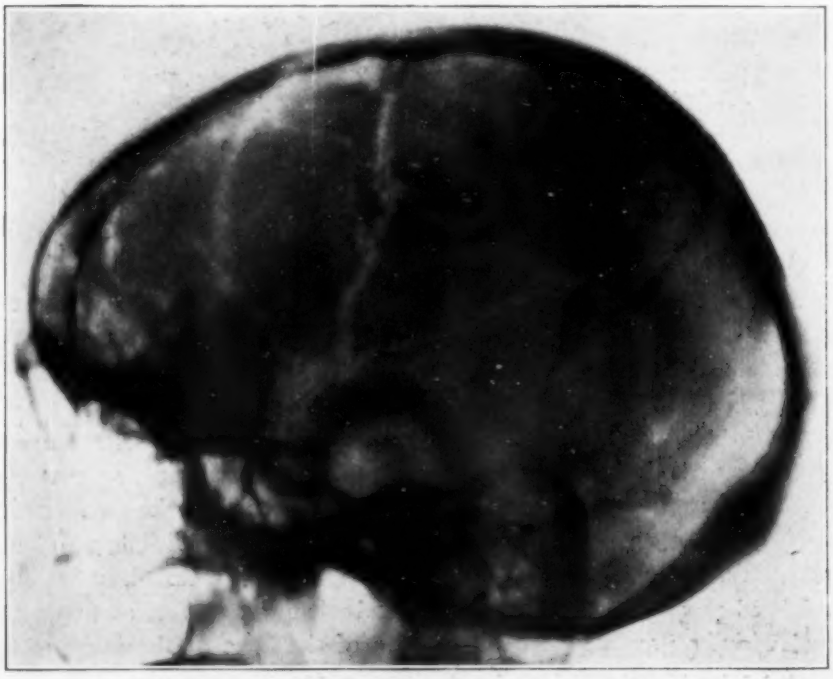

Fig. 5.—Roentgenogram showing enlarged anterior temporal diploic channels on the left. The symptoms were thought to be due to endocrine disturbance.

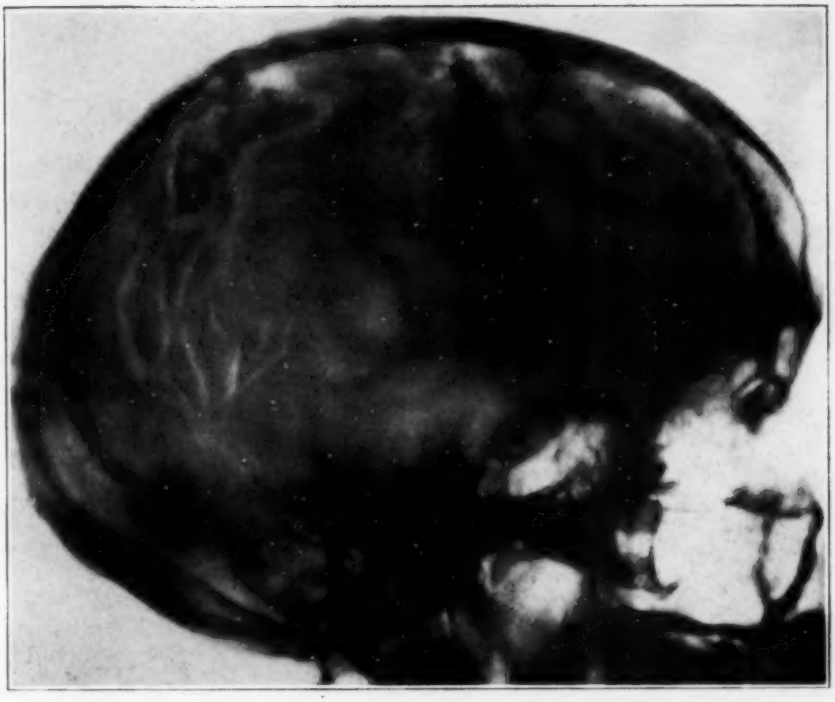

Fig. 6.—Roentgenogram showing marked increase in size and number of posterior temporal veins on the left. (Plate slightly retouched.) Marked pyramidal tract signs on right side of body, with choked disks.

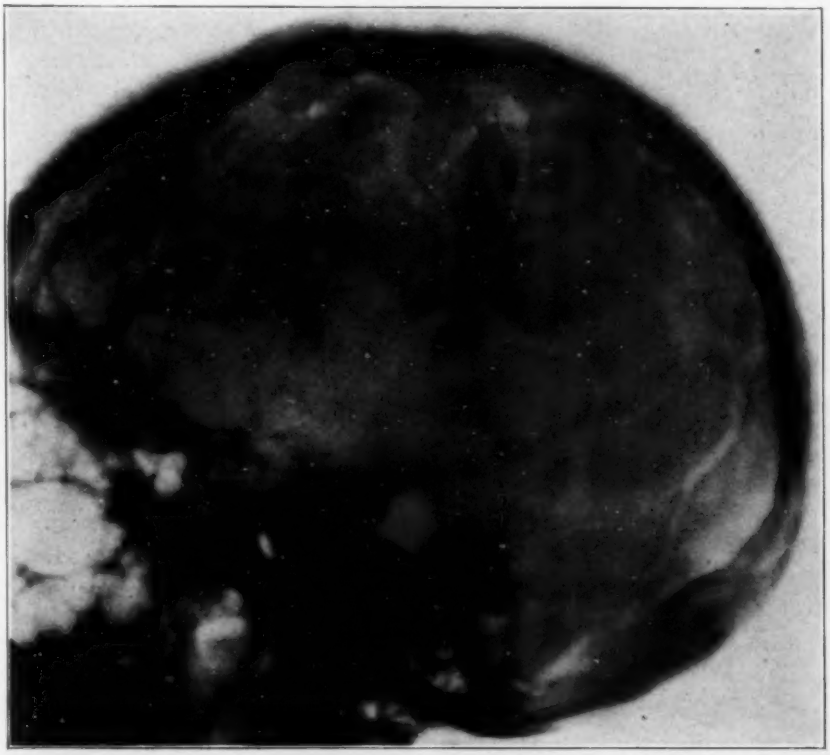

Fig. 7.—Roentgenogram showing great enlargement of the diploic veins on the right side of the skull. Jacksonian epilepsy affected especially the left arm and hand.

DIPLOIC VEINS

Enlargement in the size and increase in the number of the diploic veins are rarely found in the skulls of normal individuals. Thus, in about the last 1,000 roentgenograms of the skull taken in the roentgen-ray department of the New York Neurological Institute under the

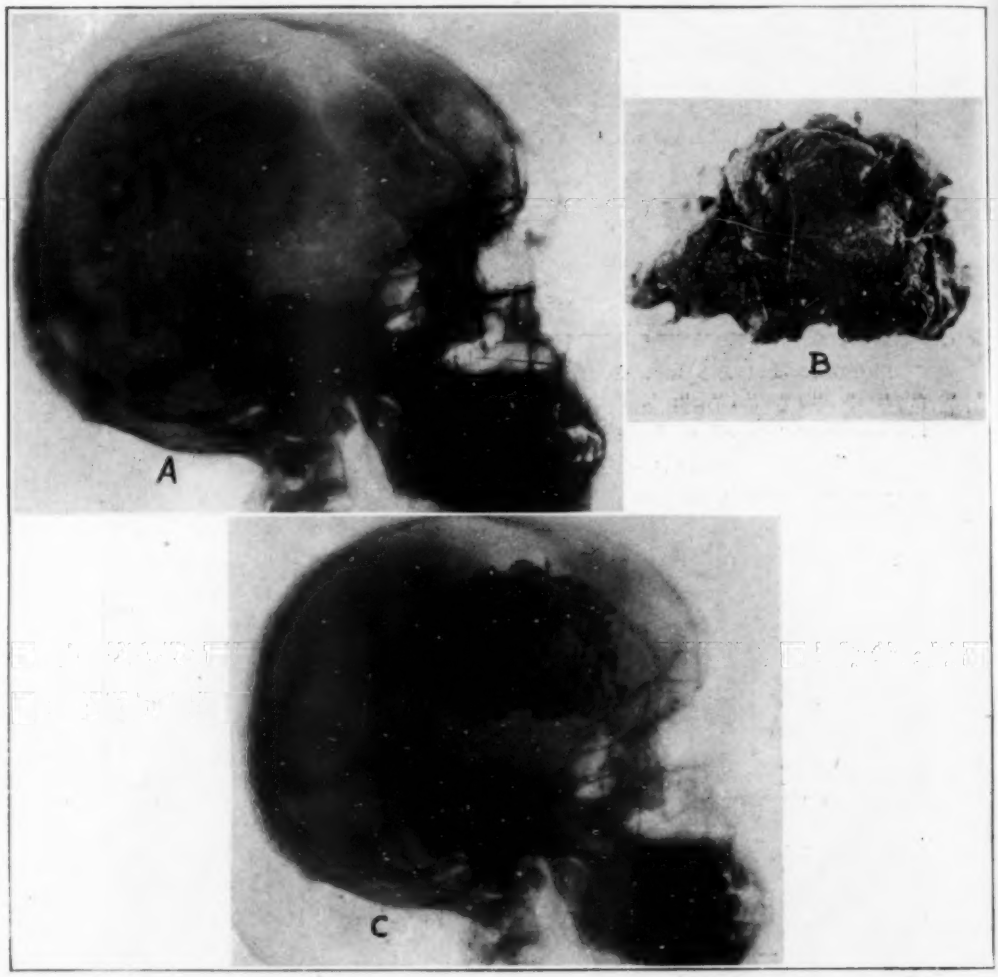

Fig. 8.—Endothelioma of right frontal and parietal lobes. *A*, roentgenogram of skull; *B*, the tumor; *C*, the tumor superimposed on the roentgenogram.

care of one of us (C. W. S.), an increase in the vascularity of the diploe was observed in approximately eighty cases (8 per cent.). The increased vascularity was bilateral in approximately sixty cases (6 per cent.) and unilateral in approximately twenty-eight cases (2.8 per cent.).

That bilateral enlargement of the veins of Brechet, and increase in the size and depth of the depressions in the skull for the pacchionian bodies, often occur after long standing increase of intracranial pressure is well known. The increase in size and number of the venous markings seen in the roentgenograms of these patients is the direct result

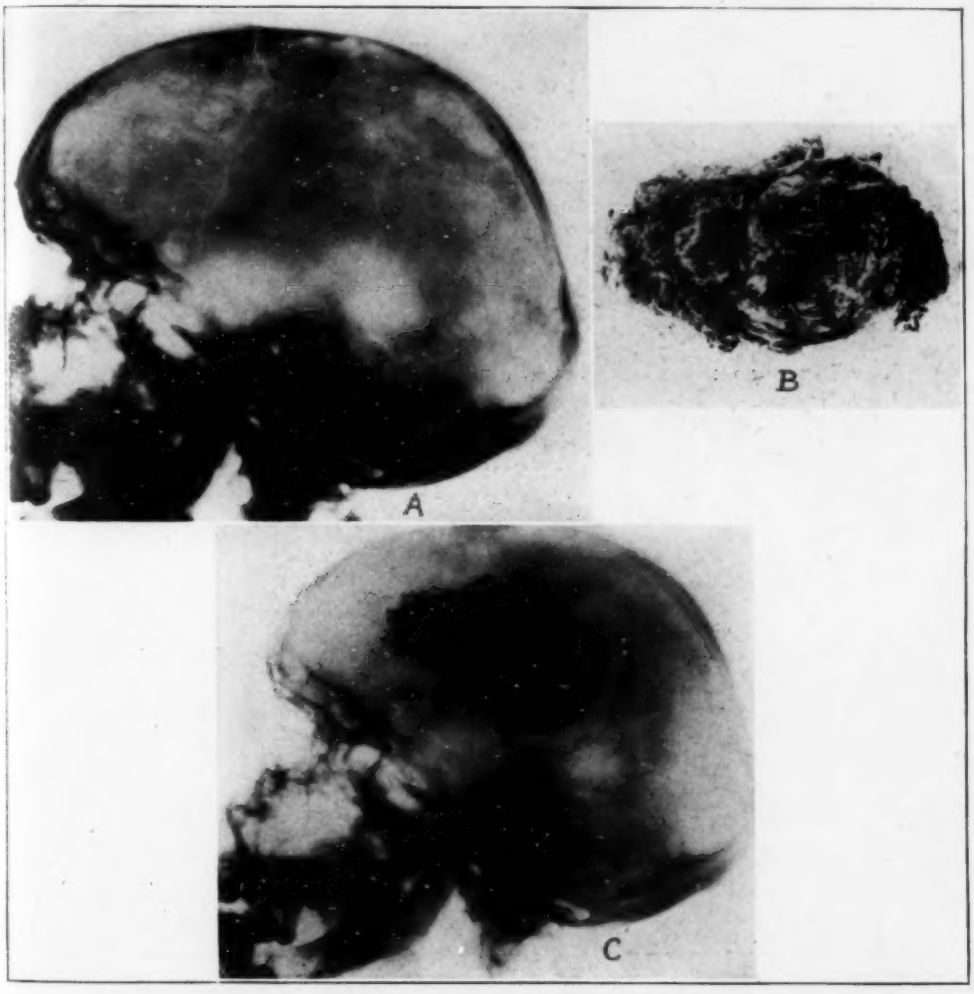

Fig. 9.—Endothelioma of left frontal and parietal lobes, showing enlargement of left anterior temporal diploic veins.

of the compression of the cerebral veins, the interference with the venous circulation within the cranial chamber, and the collateral enlargement of the veins of the diploe.

When there is a general increase of intracranial pressure, a large number of these vascular channels in the bone may become enlarged

on both sides of the skull.[1] This general enlargement of the diploic venous channels has significance as additional evidence of a long standing increase of pressure, but is of no help for the localization of the disease. If, on the other hand, the obstruction to the venous circula-

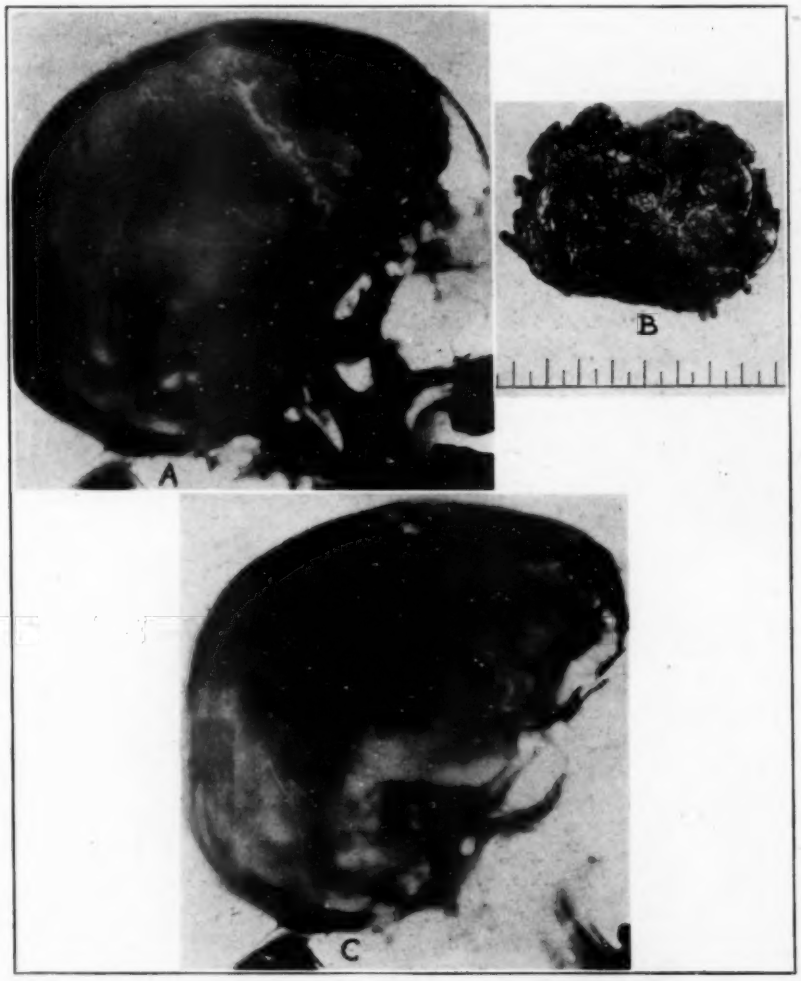

Fig. 10.—Right frontoparietal endothelioma, showing enlargement of right anterior temporal diploic veins.

tion is more localized, one or another of the diploic venous systems may be involved alone and this enlargement has localizing value.

1. In order to study the size and arrangement of the diploic veins on the two sides of the skull, stereoscopic views of both sides must be available.

Theoretically, a unilateral and localized enlargement of the venous channels in the bone should occur after a long standing unilateral obstruction to the venous flow.

A study of roentgenograms of skulls in which a unilateral enlargement of the diploic veins was found, showed that these cases could be

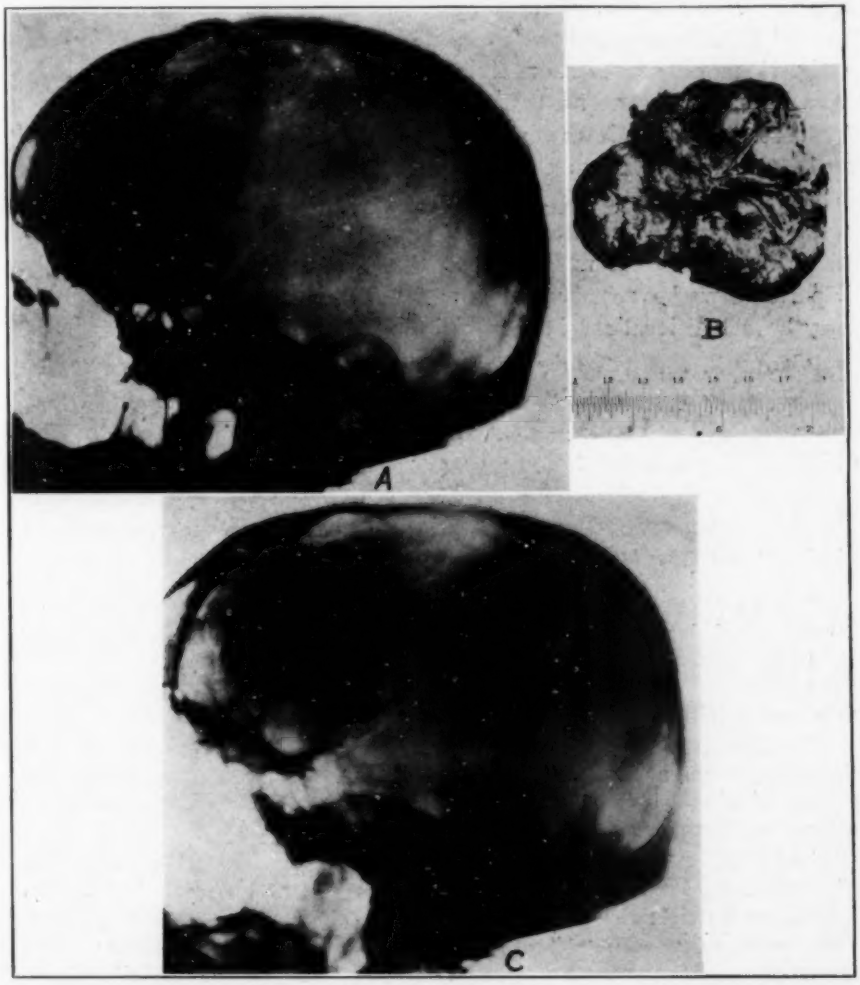

Fig. 11.—Endothelioma of left frontal lobe. Roentgenogram showing enlargement of left anterior temporal diploic veins.

divided into three groups: (1) patients who, at the time the examination was made, did not present either definite physical signs or symptoms of an organic lesion of the skull or the intracranial contents, or had only general symptoms and signs; (2) patients who had—when

they came under observation—symptoms or signs of disturbed function on the corresponding side of the brain; (3) patients with tumor of the brain, especially with the meningeal endothelioma (meningioma).

GROUP 1. *Patients who, at the time the examination was made, did not present either definite physical signs or symptoms of an organic lesion of the skull or the intracranial contents, or had only general symptoms and signs.* (Six cases).—Four of the patients presented mental disturbances and were classified clinically as having melancholia (Fig. 4), psychoneuroses, or senile dementia. In one patient the enlarged vessels visible on the roentgen-ray plate occurred in an epileptic with hydrocephalus, and in the sixth case (Fig. 5) the patient was supposed to be suffering from an endocrine disturbance, but she complained of hyperesthesia of one side of the face. Most of the six patients of Group 1 were clinic patients, but none of them came to operation or necropsy, so that errors in diagnosis could not be excluded. From the experience we have had we believe that at least some of these patients may have had localized intracranial disease.

GROUP 2. *Patients who had—when they came under observation—symptoms or signs of disturbed function on the corresponding side of the brain.* (Ten cases).—This group is a very interesting one, and we think it is probable that all of the patients had an organic lesion in the affected cerebral hemisphere which caused an interference with the flow in one or the other of the diploic veins. A short resumé of clinical histories of some of these patients follows:

CASE 1.—M. T., 60 years of age, presented marked neurotic symptoms of several years' duration. The fundi were normal. The tendon reflexes on the right side of the body were much more active than those on the left. The roentgenogram shows a marked enlargement of the posterior temporal diploic vein on the left side of the skull.

CASE 2.—A. S., 37 years of age, complained of failing memory and of a whistling sound in the left ear. His makeup was of a pituitary type. The results of physical examination were negative. The roentgenogram shows a large anterior temporal diploic vein on left side of skull.

CASE 3.—C. G., 38 years of age. The clinical diagnosis was Paget's disease. The symptoms were of several years' standing and progressive. The tendon reflexes on the right side were more active than those on the left; ankle clonus was present on the right. The fundi were normal. The roentgenogram shows increase in size and visibility of all the diploic veins of the left side of the skull, especially the anterior and posterior temporal diploic veins.

CASE 4.—C. U., a young man, complained of headache, speech difficulty, diminution in vision and weakness of the right arm and leg. Physical examination: High grade of choked disk, weakness of right face of the supranuclear type, weakness of right arm and leg, exaggeration of tendon reflexes on right side, right ankle clonus. Exploratory craniotomy: A large osteoplastic flap was turned down on the left side, exposing the motor area and adjoining parts of the occipital and parietal lobes; there was moderate increase of pressure;

no distention of ventricles; no evidence of tumor. One year later: the fundi were normal; some speech difficulty persisted, and pyramidal signs were still present, as before the operation. A tumor was suspected still. A roentgenogram of the skull (Fig. 12) showed convolutional atrophy and a marked increase in the size of the left posterior temporal system of diploic veins.[2]

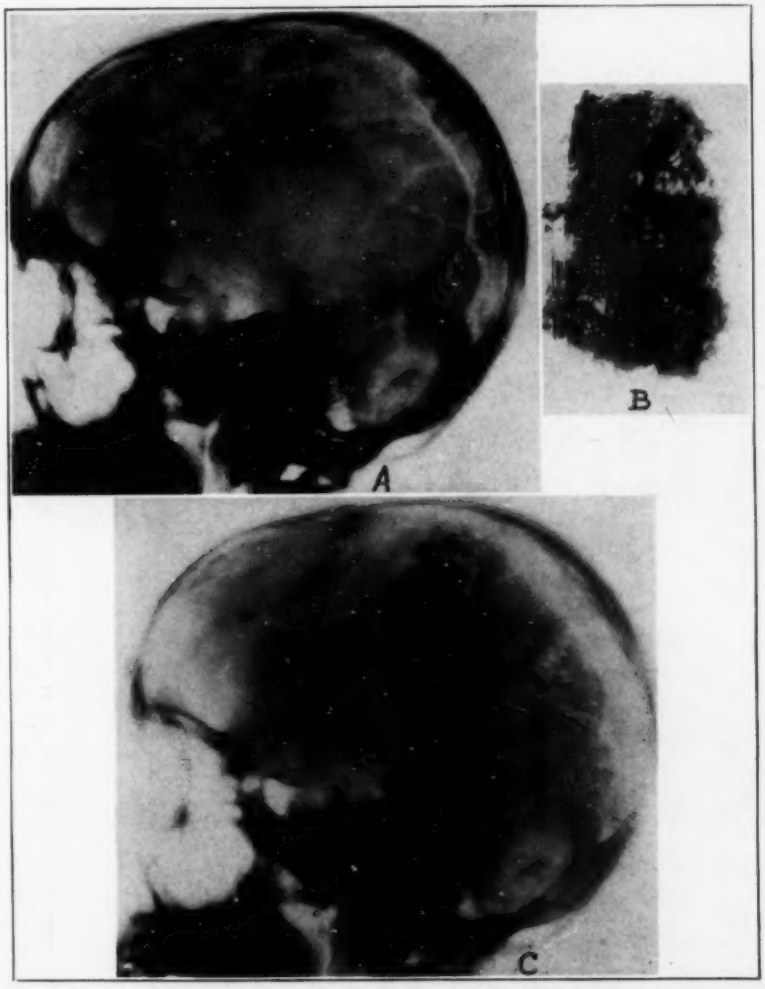

Fig. 12.—Endothelioma of left occipital lobe. Roentgenogram showing enlargement of left occipital diploic vein.

CASE 5.—A. H., a man with mental deterioration and loss of memory of many years' duration; no cranial nerve disturbances; the tendon reflexes were more active on the right side. No progression of symptoms. A roentgenogram of the skull shows marked enlargement of left frontal diploic vein.

2. This patient died suddenly six months after the exploratory craniotomy, but, unfortunately, permission for a necropsy could not be obtained.

Case 6.—Mrs. S. was a middle aged woman with a history of convulsive attacks on the left side of the body which always began in the left thumb and involved the left hand and arm. In some of the attacks the left face and left lower extremity were also involved; and, in a few attacks, the convulsion became generalized with unconsciousness. The attacks had occurred off and on for eighteen years. The results of physical examination were negative except-

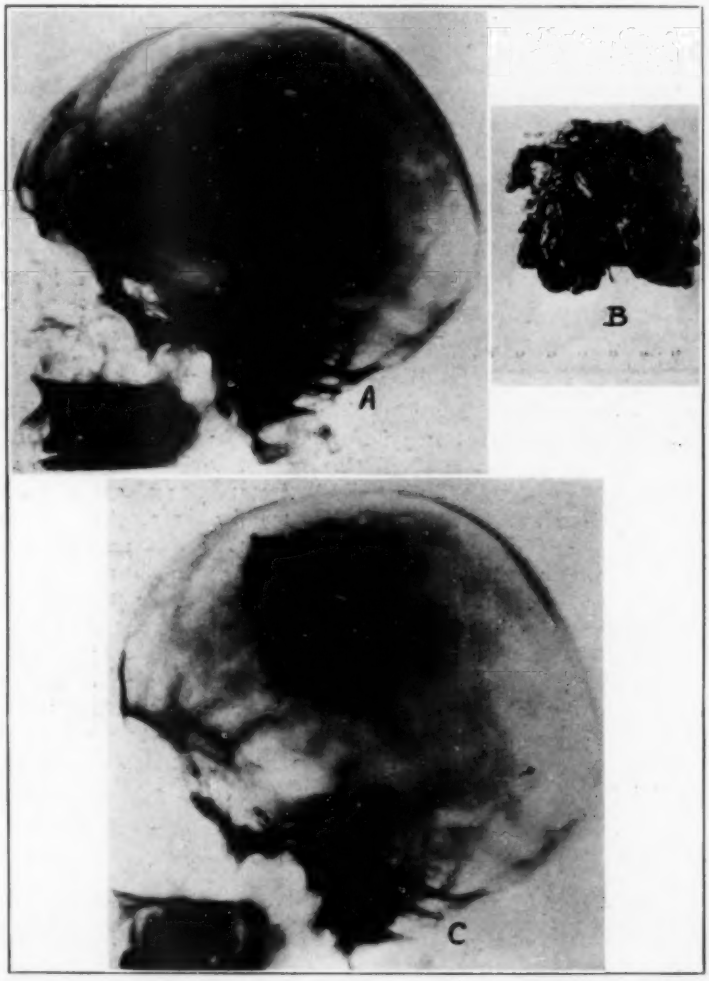

Fig. 13.—Endothelioma of left parietal lobe. Roentgenogram showing enlargement of anterior and posterior diploic veins on the left side of the skull.

ing for some stiffness of the fingers of the left hand. Exploratory craniotomy showed a marked enlargement of the diploic channels on the right side of the skull, but a normal cortex. The roentgenogram of the skull (Fig. 7) showed an enormous enlargement of the diploic veins on the right side of the skull.

CASE 7.—Mrs. F. had had mental disturbances for three years, but the symptoms were not progressive. There were present: postneuritic atrophy of the disks; right facial weakness, and exaggeration of the reflexes on the right. The roentgenogram shows a marked enlargement of the frontal diploic vein on the left side.

Of the ten patients of this group, only two were operated on. Most of the other patients remained under our observation for only a short time; in none of them was the diagnosis made with certainty. Some

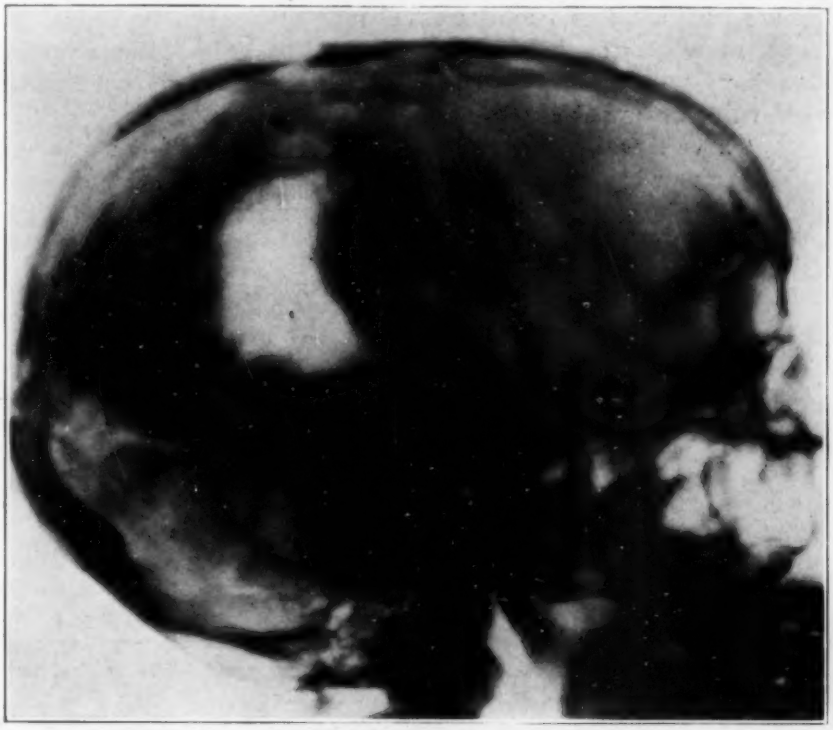

Fig. 14.—Cystic subcortical glioma in the right parietal lobe. Roentgenogram showing air in the cyst cavity and enlarged anterior temporal veins on the same side.

may have had expanding intracranial disease which had become quiescent.

GROUP 3. *Patients with tumor of the brain, especially with the meningeal endothelioma (meningioma).* (Twelve cases).—All but two of the patients in this group had dural tumors that were removed at operation. Two patients had large cystic subcortical growths which lay near the surface of the brain.

Figures 8 to 13 (inclusive) are roentgenograms of the skulls of six of the patients. In each case the illustration consists of: *A*, the

radiogram of the skull; *B*, the tumor which was removed; *C*, roentgenogram of the skull with the tumor superimposed in the location in which it was found at the operation. In each instance, the enlarged diploic veins lay below and in the location of the new growth. Figure 14 is the roentgenogram of one of the patients with a cystic subcortical growth in the left parietal and occipital lobes, and shows the cyst cavity filled with air.

SUMMARY AND CONCLUSION

We have not found unilateral enlarged diploic veins in any other of the many gliomas that have been verified by operation or necropsy. Nor have we found unilateral enlargement of venous channels in metastatic tumors of the skull or brain.

We have therefore arrived at the conclusion that if the diagnosis of brain tumor has been made, and unilateral enlarged diploic channels are found in the general area in which the tumor is suspected, there is considerable probability that the new growth is an endothelioma.

DISCUSSION

Dr. William G. Spiller, Philadelphia: Dr. Elsberg has not clearly stated the clinical significance of this vascularity of the brain; he has given us a number of plates in which this vascularity has been shown, without deriving any clinical significance from it. I should like to know the proportion in which vascularity occurs without clinical significance. Dr. Elsberg has stated that in more than 50 per cent. of endotheliomas there is increased vascularity, and that it does not occur in gliomas. This sign, therefore, becomes of considerable importance in endothelioma of the brain, especially when we have no cranial enlargement, since there are cases of endothelioma without enlargement of the bone. I presume that a glioma does not give this vascularity of the surface because it is more commonly deep within the substance of the brain; the vascularity, therefore, is within the brain substance rather than on the surface, and would not show in the roentgenogram. The method may be of value in differential diagnosis.

Dr. Ernest Sachs, St. Louis: Vascular changes in the bone have been noted for a number of years. From what Dr. Elsberg said, I gather that in cases in which there are no local changes and evidence of an endothelioma, little significance is to be attached to the presence of enlarged diploic vessels or enlarged meningeal vessels.

Dr. Morton Prince, Boston: Will Dr. Elsberg state to what extent control observations were made?

Dr. Harvey Cushing, Boston: Many patients with obscure intracranial troubles show stellate dilatations of the vessels in the region of the parietal eminence, and I have been confused more than once by them. I do not think they have special significance in the absence of other symptoms. Intracranial tumors may cause marked dilatation of these and other diploic vessels, but enlargement of the sinusoidal channels in the bone, in the sphenoparietal groove in particular, is of greater significance. This is the sinus most commonly found enlarged and it is apt to run into a branching dilatation of vessels as it

approaches the longitudinal sinus. When tumor causes stasis in these sinuses there is rapid absorption of bone under pressure. This is a well-known indication of intracranial tension. Dr. Elsberg apparently believes that the dilatation of vessels that accompanies the endotheliomas is partially due to increased local vascularity produced by a growth adherent to the dura; but also in part to the fact that the growth often comes from one of the larger sinuses and the stasis thereby produced backs up into the bone and causes widening of these channels.

Dr. Elsberg, in closing: Dr. Cushing has mentioned two important facts regarding the subject under discussion. Both Dr. Schwartz and I feel that the dilatations of the vascular channels in the parieto-occipital regions probably had no significance. There is a great probability that these are venous channels, which have become dilated for the reason that Dr. Cushing mentioned. It cannot be purely a condition of increased intracranial pressure because we have examined roentgenograms of a large number of skulls in which there had been a long-standing increased intracranial pressure and it was rare to find any change in the vascularity of the skull, excepting in individuals with very thin skulls. Unilateral enlargement of the vessels, such as were illustrated in the lantern slides, does not occur ordinarily in increased intracranial pressure. We have not seen it in one instance of posterior fossa lesion, the type of case in which intracranial pressure often is increased for a long period. Whether local increase of intracranial pressure has anything to do with the changes in the bone, one cannot say. Our main object in presenting this matter was: When these enlarged vascular channels are seen unilaterally in a nonprogressive case, they may have no significance, although there may be a correspondence between the changes on one side of the skull and the symptoms on the other side of the body. But when these changes are found in the early symptoms of a progressive disease, and the side of the skull on which they occur corresponds to the physical signs and symptoms, then the diagnosis of brain tumor in that location is made more certain, and the probability of an endothelioma is enhanced.

VON RECKLINGHAUSEN'S DISEASE

WITH ESPECIAL CONSIDERATION OF THE ENDOCRINE CONNECTION *

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Something has been written of the connection of neurofibromatosis with endocrine disturbance. Most writers have called attention to the very frequent and, at times, marked pigmentation occurring in connection with the disease. Goodhart [1] implicates the suprarenal glands but does not report results obtained in administering the gland extract. Involvement of the pituitary gland is suggested by Roubinovitch and de la Sourdière (quoted by Goodhart) who found acromegaloid changes in a mother and son with neurofibromatosis; Barber and Shaw [2] reported a case with bilateral optic atrophy, sexual precocity and a shadow in the sella turcica thought to be that of a tumor, though not confirmed by operation or necropsy. Leir (quoted by Goodhart) found dystrophia adiposogenitalis, with roentgen-ray and ophthalmoscopic changes suggesting tumor of the pituitary in a boy; likewise unconfirmed by operation or necropsy.

Mallan [3] reported the case of a boy, aged 8 years, who had pubic hair, low-pitched voice and adultoid sexual organs. He was clumsy, had headaches and was easily fatigued. A roentgenogram of his sella gave negative findings. Mallan thought he had von Recklinghausen's disease and a tumor of the pineal gland but as the skin growths disappeared this can hardly be considered a case of neurofibromatosis.

With little foundation, disease of the thyroid, parathyroids, thymus and sex glands have been thought to be connected with neurofibromatosis. With more reason, a connection with the suprarenals has been thought to exist, adenoma and atrophy of the suprarenals having been found by Chauefferd and Ramond (quoted by Funk). Saalman found hypernephroma, and Kawashima [4] found a tumor of the suprarenal in von Recklinghausen's disease.

Christin and Naville [5] reported thirty-one tumors of various histo-

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* Read at the Forty-Ninth Annual Meeting of the American Neurological Association, Boston, May 31, 1923.

1. Goodhart, S. P.: Article in Practice of Medicine by Frederick Tice, Hagerstown, Md., W. F. Prior Co., **10**:665, 1921.
2. Barber and Shaw: British J. Dermat. & Syph. **34**:207 (June) 1922.
3. Mallan, Ernest: British J. Dermat. & Syph. **34**:239 (July) 1922.
4. Kawashima: Virchow's Arch. f. path. Anat. **203**:66, 1911.
5. Christin, E., and Naville, F.: Ann. de méd. **8**:30 (July) 1920.

logic structure found within the skull of one patient. There seems to have been no cutaneous manifestation in this case. These authors collected twenty-three cases of central neurofibromatosis in which cutaneous neurofibromas occurred in only about two-thirds.

Ewing[6] states that tumors in neurofibromatosis may occur in the jejunum, ileum, colon, bladder and vagina, and refers to reported cases in which tumors were found in the pleural cavity, along the intercostal and lumbar nerves, the intervertebral ganglia, the terminal filaments of the sympathetic, and, in several instances, in the suprarenal gland.

The following cases are reported to show the endocrine connections and central nervous system lesions found in von Recklinghausen's disease.

REPORT OF CASES

CASE 1.—*Neurofibromatosis with symptoms of a cerebral lesion, atrophy, eyelid involvement and endocrine disturbance.*

This man, aged 38, whose family and past history was unimportant, except that he had had malaria one year previously, was seen in April, 1920, when he complained of vertigo and fatigue, numbness and tingling of the hands, lessened power in the hands, difficulty in holding objects, unsteadiness in gait, occasional frontal headaches and insomnia. Examination revealed a rather short man with large features, and with numerous neurofibromas scattered over his trunk, face and extremities, one of them involving the left upper eyelid. The nose, lips and ears were large and thick, the brow was prominent, and the head was large and out of proportion to the rest of the body. The head hair was coarse, thick and dry, but he had little beard and no body hair. The arms were long, reaching almost to the knees; the hands large, long and bony (Fig. 1). There was general bronzing of the skin with more deeply pigmented areas on several parts of the body.

Neurologic Examination.—This revealed slight swaying in station; all deep and superficial reflexes were active and equal, and there was slight upper and lower ataxia, with definite weakness in the grip of each hand. There was some atrophy in the shoulder girdles, and marked atrophy of the thenar and hypothenar eminences bilaterally. Sensation and sense of position were normal. There was difficulty in the performance of finer movements of the fingers. There were no tremors. Speech was clear and the fundi were normal. There was slight weakness of the left side of the face and some nerve deafness in the left ear; ptosis was present from swelling of the left upper eyelid, and there was a coarse lateral nystagmus. The mentality was normal. The muscles showed no reaction of degeneration.

Laboratory Findings.—The blood Wassermann reaction was negative. Roentgen-ray findings of the head and sella turcica were negative.

Outcome.—The patient died of pneumonia in 1922 at another hospital and no necropsy was obtained.

CASE 2.—*Neurofibromatosis with elephantiasis nervorum on the right wrist and under the left breast, lesions of the central nervous system, and of several endocrine glands. Necropsy.*

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6. Ewing, James: Neoplastic Diseases, Philadelphia, W. B. Saunders Company, 1919.

The patient, a white woman, aged 35, with unimportant family and past history, except that one of her children had died of a cerebellar cyst and she herself had had influenza in 1920, came under observation in January, 1923. She had several neurofibromas on the body, arms and face, one on the right leg and two large redundant elephantine masses—one on the right wrist, and another under the left breast (Fig. 2).

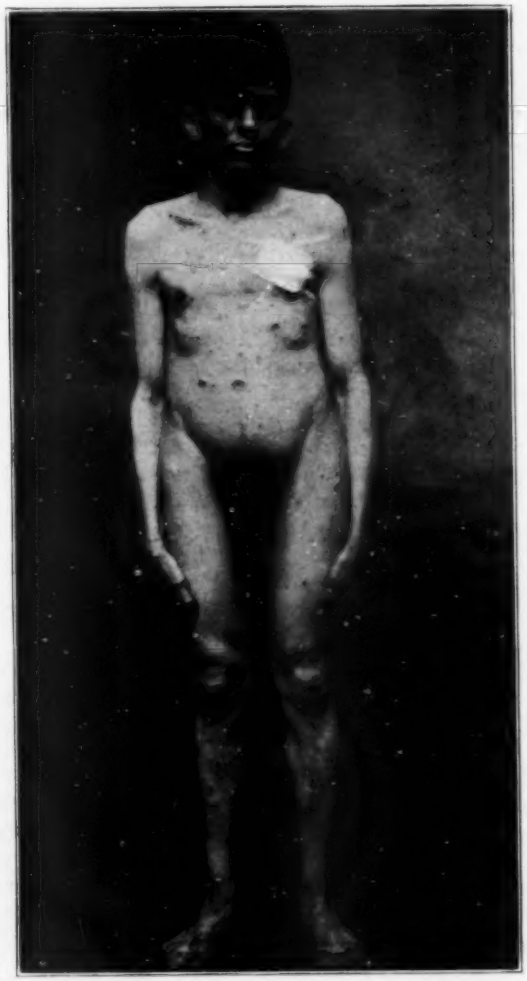

Fig. 1.—Neurofibromatosis, with a nodule on the left upper lid, acromegaloid features and very long arms.

The skin was markedly bronzed with several densely pigmented areas on the body. There was marked retraction of the neck and pain in the neck, left shoulder and arm. There was general atrophy and emaciation, the atrophy being marked around the shoulder girdle and in the hands. The left arm was paretic.

The blood pressure was 98 systolic, 60 diastolic. The neurologic examination showed superficial abdominal reflexes absent, and exaggerated deep reflexes.

but no clonus or Babinski sign. The differential blood count, urinalysis and Wassermann reaction on the blood were negative. Mental examination revealed a rather dull, ignorant woman.

A roentgenogram of the head showed a normal contour of the skull, but wide and deep blood vessel grooves. The sella turcica was small with clubbed posterior clinoid processes. A roentgenogram of the cervical spine was negative for bone lesion, but showed marked cervical lordosis. A roentgenogram of the suprarenal regions showed no evidence of calcification.

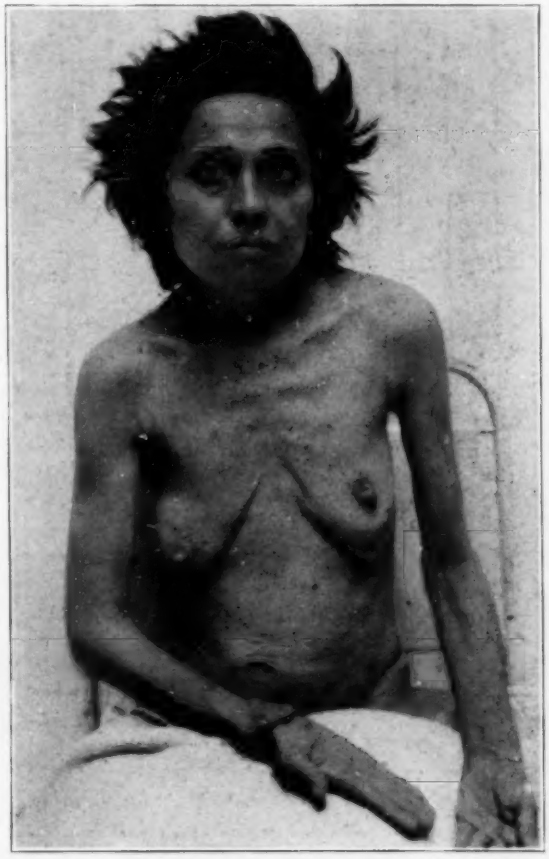

Fig. 2.—Elephantiasis nervorum under the left breast and on the flexor surface of the right wrist.

Necropsy Findings.—The patient died, April 20, 1923. A necropsy was performed by Dr. W. H. Cook, who reported as follows: Numerous nodules were scattered over the body surface, and a large pendulous mass over the right wrist appeared to be the coalescence of several soft nodules. Another mass under the left breast was soft and appeared to be a single growth. The skin was sallow with blotches of pale brown over the thighs and trunk. The face was uniformly pigmented. The skin was dry with some scaling. The subcutaneous fat was small in amount and the muscles were thin and flabby. On the upper

jejunum was a small dark nodule with a gross appearance of a mole. The pituitary body was removed and appeared normal; the thyroid was within the normal limits in size and consistency; a small amount of thymus tissue was present. Nothing abnormal was noted about the pancreas. The suprarenals were normal in size, color and consistency. The ovaries were smaller than usual.

In the medulla there was a tumor measuring 3 cm. in width which tapered sharply at the foramen magnum to 2.2 cm. and extended into the upper part of the cord. The tumor was of hour-glass shape and had the appearance of a

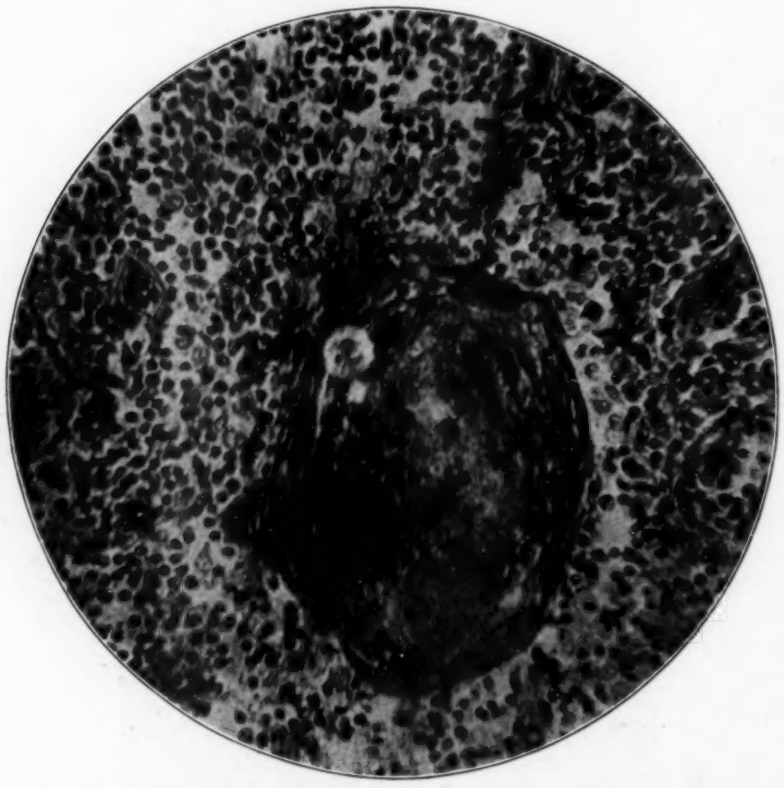

Fig. 3.—Persistent thymus showing large Hassall corpuscle. (Most of the Hassall corpuscles in this section were of normal size.)

glioma. There was an area of softening in the cord, about 6 cm. in length, situated at the lower dorsal and upper lumbar junction.

Microscopic Findings.—Dr. W. S. Budd reported: The tumor in the medulla was a fibro-endothelioma. There was hyalogranular degeneration of the dorsolumbar region of the cord. The persistent thymus was normal, with Hassall's corpuscles present (Fig. 3). There was cloudy swelling in the suprarenal gland cortex with more fat cells than normal (Fig. 4). Examination of the medullary portion showed normal tissue. The pituitary was normal, but the ovaries showed absence of graafian follicles and the presence of atrophic changes.

CASE 3.—*Neurofibromatosis with acromegalic disturbance.*

This man, aged 52, whose family history was unimportant, had had typhoid and malaria as a child and an inflammatory condition of the hands three years before he came under observation Jan. 23, 1923. Six months before admission he had symptoms of stone in the left kidney. On admission, he complained of pain in the left kidney and shortly afterward a large stone was successfully removed. The face, neck, arms and torso were covered with neurofibromas and a few were found on the lower extremities. The patient stated that these began when he was about 37 years of age and had gradually extended. They were painless, except that in hot weather they itched. No new nodules had appeared in the previous two years.

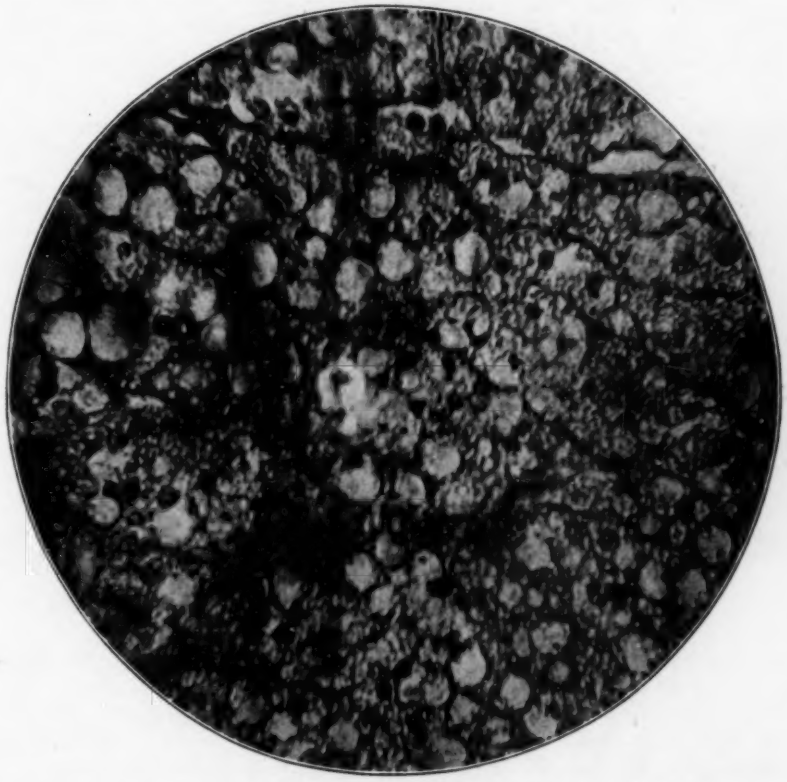

Fig. 4.—Extreme fatty changes in the stratum granulosum of the suprarenal.

The general examination showed the blood pressure 120 systolic, 70 diastolic. Hair was scant over the body and pubes, and absent in the axillae. The hands and face were moderately enlarged and there was a moderate general increase in pigment. A differential blood count and blood Wassermann test gave negative results. There was no atrophy. A roentgenogram of the head revealed moderately general increase in thickness of the skull bones, and the blood vessel grooves were more marked than usual. The sella was enlarged and deepened (Fig. 5).

CASE 4.—*Neurofibromatosis with hereditary and familial factors and evidence of endocrine disturbance.*

This patient, a man aged 43, stated that his mother, two brothers and a sister had neurofibromatosis. His personal history was unimportant and when seen Feb. 4, 1923, he complained of lessened sexual power, drowsiness, fatigability and loss of weight. The nodules were generally distributed, the greatest number being over the face and torso. There was general bronzing of the skin, with areas of more marked pigmentation. The patient weighed 82½ pounds (36.5 kg.). The body hair was scant in the axillae and on the torso, and of the feminine type at the pubes. The genitals were of normal size. He was of the gonadal type, his span being four inches greater than his height. The neurologic examination showed a slight sway in station, fine hand tremors, a somewhat weakened grip, and facial asymmetry without paralysis of the facial nerve. There was atrophy of the facioscapulohumeral type, but no fibrillary tremors could be detected. His mental examination showed moderate depression, self-

Fig. 5.—Acromegaloid type. Slightly large and rather deep sella turcica.

centeredness and apprehension. His blood pressure was 110 systolic, 76 diastolic. The Wassermann test was negative.

Roentgenograms showed: no calcification of the suprarenals; the blood vessel and sinus grooves of the skull broad and deep; the skull bones not thickened; the sella turcica large and deep, the horizontal measurements being 13 mm. and the vertical 10 mm.; the posterior clinoids were massive, but the outlet of the fossa measured 3 mm. There was no clinical evidence of acromegaly. This patient took surprarenal gland extract for a year without benefit. The microscopic appearance of a nodule is shown in Figure 7.

CASE 5.—*Neurofibromatosis with trigeminal elephantiasis nervorum, spasticity and endocrine symptoms.*

The patient was a colored man, aged about 30, who had always been healthy and denied the existence of any similar condition in his family. When seen for the first time in March, 1923, he stated that he had had sagging of the right side of his face as long as he could remember, and had been told that this condition was present at the time of his birth. He had many neurofibromas on his

torso and a few on both the upper and lower extremities. The head was flat at the vertex and the occiput prominent. There was a right lateral middorsal scoliosis. The left eyeball was rather prominent, but he stated this had always been the case. His thyroid was not enlarged.

Neurologic examination revealed slight bilateral ankle clonus, very active abdominal reflexes, exaggerated but equal. There was no mental abnormality.

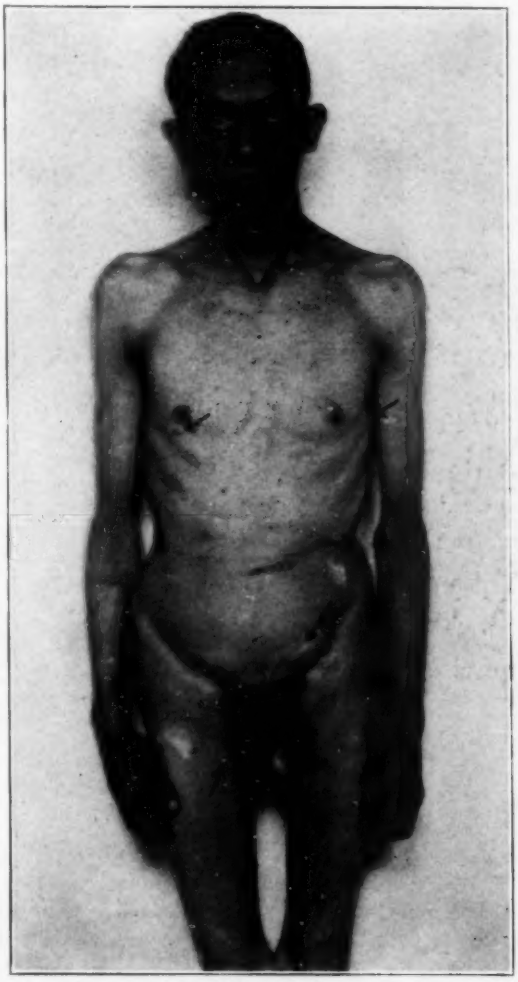

Fig. 6.—Gonad type, atrophy, facial asymmetry and pigmentation.

There were various areas of pigmentation over the body, very little face hair, no axillary hair, no hair on the torso and feminine distribution of the pubic hair. The genitals were normal. Perspiration was scanty. A roentgenogram of the head and face showed a thick skull flattened at the top, marked atrophy of the bones of the right side of the face, and a deformed, shallow and rather small sella turcia.

The trigeminal elephantiasis nervorum involved the right temporal scalp, part of the right frontal skin, the right ear, eye, nostril and right half of the lip and chin. Its dimensions are best judged by referring to the accompanying photograph (Fig. 8).

CASE 6.—*Uncomplicated neurofibromatosis; a daughter has pigmented areas on the skin similar to those of the father.*

The patient, a colored man, aged 29 years, whose daughter, aged 8, had pigmented areas on her skin resembling those on his own skin, though without nodules, came under observation May 1, 1923. He stated that the pigmented

Fig. 7.—Typical neurofibroma showing cellular fibrous tissue in which are nonmedulated nerve fibers.

areas on his skin were present at the time of birth and that the nodules were noticed when he was about 10 or 12 years of age. He had had rheumatism two years before he came to the clinic. The patient had marked scoliosis; the body hair was normal. The results of examination, general, neurologic and mental were negative, and there was no evidence of endocrine disturbance, except pigmentation.

CASE 7.—*Neurofibromatosis with elephantiasis nervorum of the gluteal region.*

The patient, a colored woman, aged about 30, in whose family there was no history of neurofibromatosis, was admitted May 1, 1923. Nodules had begun to appear on her body when she was about 8 years of age. Two years before

admission she had been operated on for fibroids of the uterus and she came back at this time for recurrence of fibroids in the abdominal muscles. There were markedly pigmented areas on the skin, especially on the forehead and back. The blood pressure was 130 systolic, 84 diastolic. There was no hair on the torso, but axillary and pubic hair was normal. On the upper lip was a distinct mustache and on the chin a slight beard. There was no atrophy. Moderate scoliosis was present. The Wassermann reaction was negative.

Fig. 8.—Elephantiasis nervorum of the trigeminal region. The eyelids were displaced downward four inches and the patient had neurofibromatosis of the arms and trunk.

There was a huge elephantiasis nervorum of the gluteal region of both sides, more marked on the right, and a small one on the right side of the abdomen. Small neurofibromas were scattered over the body.

The neurologic, mental and roentgen-ray examinations gave entirely negative results.

CASE 8.—*Neurofibromatosis with signs of acromegaly.*

This patient, a white man, aged 42, whose family and past history was unimportant, except that he had had hemorrhoids, was first examined May 4,

1923. Nodules were profusely scattered over the face, scalp, body and all extremities. The patient stated that he had noticed that the nodules enlarged after eating red meats, especially ham, drinking whisky and when constipated. The patient made no subjective complaints. There were numerous small pigmented spots all over the body. The head hair was dry and wiry, body hair normal.

Neurologic and mental examinations gave entirely negative results. Several blood Wassermann tests were negative. The blood pressure was 124 systolic, 62 diastolic. There was a right upper dorsal lateral scoliosis. There was no atrophy. The patient had prominent cheek bones, brows and prognathism.

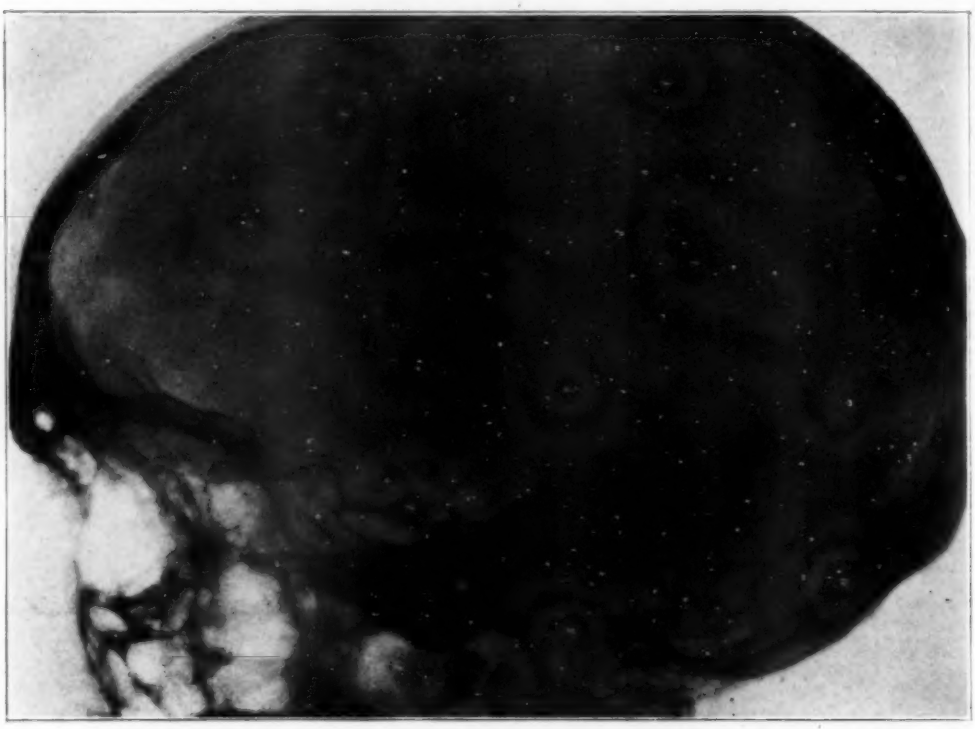

Fig. 9.—Large box shaped sella, skull walls rather thick.

Roentgen-ray examination showed an enormous pituitary fossa 17 mm. in horizontal diameter, 14 mm. in vertical diameter and an outlet of 11 mm.; there was no evidence of erosion. The posterior clinoids were long and slender. The skull walls and face bones were not thickened. The blood vessel grooves in the skull were deep and broad.

CASE 9.—*Neurofibromatosis and hyperpituitarism; the tumors followed the median and ulnar nerves and appeared after tetanus antitoxin and local infection.*

This patient, a man, aged 39, whose family and past history was negative for serious disease, was examined May 13, 1923. In 1918, tumors appeared in the left arm, two months after an immunizing dose of tetanus antitoxin injected into that arm. After four or five months, nodules appeared in the right arm.

The antitoxin injection had been followed by slight local infection, which soon healed. The tumors were under the skin, rather firm in consistency and of moderate size. The larger tumors were painful and followed the distributions of the median and ulnar nerves of the arms. There were also a few nodules on the body and extremities.

The general examination gave negative results though he complained ot temporal headache. There was breast girdle obesity, but no atrophy nor special pigmentation. The blood pressure was 130 systolic, 90 diastolic. Neurologic examination was negative except for slight unsteady station, slight weakness in the grip of the left hand and slight right facial weakness, probably due to asymmetry. The mental examination was negative.

A roentgenogram of the head (Fig. 9) showed the skull wall rather thick, the sinuses negative and the pituitary fossa box-like in shape. The anterior walls of the sella were almost perpendicular with the anterior clinoids normal and the posterior clinoids long and bent forward. The sella measured 13 mm. in the horizontal and 12 mm. in the vertical diameter with an outlet of 4 mm.

SUMMARY OF ENDOCRINE DISTURBANCES

In the cases described there was no evidence of involvement of the pineal, thyroid, parathyroid or pancreas, and only one case showed an increase of thymus tissue. The pituitary was most frequently involved. In Cases, 1, 3 and 8 there were acromegaloid manifestations. In one case there was definite evidence of under-activity of the pituitary gland. The roentgen-ray findings were of interest. In Case 3 the sella was normal, but the skull bones were thickened; in Cases 4, and 9 there was a large sella, the patients had bitemporal headache, and there was a breast girdle of fat which might be evidence of undersecretion.

The suprarenals were involved in a few of the cases; all except Case 9 had excessive pigmentation. The blood pressure was low in all except Cases 7 and 9. Axillary, torsal and pubic hair was absent or very scant in four cases and normal in five. Cases 4 and 5 showed a feminine type of pubic hair distribution, all other cases being apparently of normal type for the sex.

Necropsy in Case 2 showed degeneration of the suprarenal cortex, and undeveloped ovaries.

CONCLUSIONS

Hereditary and familial tendencies may or may not be present in neurofibromatosis. Excessive localized pigmentation commonly accompanies the disease.

It is believed that careful staining and repeated examination of the nodules will reveal both fibrous and nervous tissue in neurofibromatosis. Von Recklinghausen's statement that the tumors arise from the nerve trunk or nerve filaments apparently still holds true.

There seems to be a definite relationship between certain endocrine disorders and the disease in question. From the pituitary standpoint the characteristics are chiefly of the acromegalic type while the supra-

renal manifestations are pigmentary disturbances, lowered blood pressure and hypotrichosis. The sex glands showed no certain relationship to the disease.

Neurofibromatosis is much more common than is ordinarily supposed; its endocrine connections demand further investigation.

DISCUSSION

Dr. Francis X. Dercum, Philadelphia: Will Dr. Tucker state how many patients were negroes or mulattoes and how many were pure whites?

Dr. Harvey Cushing, Boston: This is a very protean disease, I think congenital and oftentimes hereditary. Dr. Tucker has spoken of the common involvement of the trigeminal region. Some years ago I collected from the literature a long series of such cases. Curiously enough, it occurs most often on the right side of the face, where elephantiasis nervorum or plexiform neuromata may be found. One patient had a large plexiform neuroma in the right temporal region with sagging of the face, not as extensive a condition as was shown in Dr. Tucker's picture. About three or four years ago I dissected out this region and removed the great plexiform mass of nodules and as much of the boggy elephantiasic tissue as I could. The patient returned recently because of pain in the eye and exophthalmos. Probably, I should have divided the trigeminal nerve to stop the pain, but she was unable to close her eye, and I did not like to leave her with anesthesia of the cornea. Consequently, I was undecided whether to enucleate the eye, which was what she wanted to have done, or to divide the trigeminal nerve, which would mean ultimate enucleation. I trephined the outer wall of the orbit, and as soon as Tenon's capsule was opened, a neurinoma the size of a bean was extruded. There was also a very large lachrymal gland which I dislocated from the orbit into the temporal fossa. She is now able to close her eye and has much less pain. These conditions are related to the ordinary acoustic tumors which are of course akin to neurofibromatosis. They unquestionably come from a congenital anlage of some kind; scrutiny of the skin of patients with these lesions, not uncommonly will revealed a few mollusca fibrosa, which indicate the nature of the tumor.

MORPHOLOGIC DIFFERENTIATION OF MENINGO-ENCEPHALITIS OF RABBITS AND EPIDEMIC (LETHARGIC) ENCEPHALITIS

WITH A NOTE ON THE OCCURRENCE OF PARASITES IN THE FORMER DISEASE *

JEAN OLIVER, M.D.

SAN FRANCISCO

Since my observation [1] that chronic inflammatory processes are commonly found in the central nervous system of rabbits, and that in many cases the condition takes on the form of an epidemic meningo-encephalitis, similar findings have been reported from widely separated parts of the world. In England, Twort [2] found many of his laboratory animals affected. Levaditi [3] has found similar conditions in France, and in the eastern part of the United States, Flexner [4] reports the lesions in 50 per cent. of supposedly normal animals.

The importance of the condition is obviously in the possibility that these spontaneous lesions in supposedly normal animals may be confused with the result of experimental procedure. It is interesting in this regard to consider some of the experiments which, in the opinion of the investigator concerned, have led to the production of lesions in the central nervous system of the animal. The administration of various chemical substances of widely different chemical constitution has been frequently held responsible for them, such as arsphenamin, neo-arsphenamin, mercury administrated by injection and by inunction and the feeding of manganese salts. Feeding of guanidin, or even a disturbance in the metabolism of this nitrogenous substance without the administration of it, which is assumed to follow the production of an Eck's fistula, has been described as producing inflammatory lesions in the central nervous systems of rabbits.

A critical survey of these experiments is in most cases sufficient to judge as to the relative rôle played by the experimental procedure and the possibility that the lesions are due to preexisting disease. When one considers the results of the experiments in the transmission of

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* From the Department of Pathology of the Medical School of Leland Stanford Junior University, San Francisco.

1. Oliver, J.: J. Infect. Dis. **30**:91, 1922.

2. Twort, C. C.: Vet. J. **78**:194, 366, 1922.

3. Levaditi, C.; Nicolau, S., and Schoen, R.: Compt. rend. Soc. de biol. **89**:984, 1923.

4. Flexner, S.: Epidemic (Lethargic) Encephalitis and Allied Conditions, J. A. M. A. **81**:1688 (Nov. 17) 1923.

epidemic (lethargic) encephalitis and of herpes labialis by inoculation of human material, judgment is more difficult. Flexner's critical discussion [4] gives the salient points in our knowledge of the subject. Briefly, it has been claimed that the virus may be demonstrated in the nervous tissue of fatal human cases, in the saliva of persons ill of the disease, and also in the saliva of nurses and attendants who have been in close contact with the patient. It has been suggested that this last group may act as carriers of the disease. In all the experiments, the demonstration has depended chiefly on the production of an encephalitis in rabbits.

It becomes of greatest importance, therefore, to distinguish, if possible, between the spontaneous disease of the rabbit and the encephalitis which occurs in man. The present paper emphasizes some of the morphologic characteristics which differentiate the two conditions.

SITUATION OF THE LESIONS

Before describing the lesions which occur in the two conditions, it is perhaps well to call attention to differences in the distribution of the pathologic lesions in the two conditions, as the examination of the central nervous system is considerably facilitated if those regions can be studied in which the lesions are most apt to be found.

In human encephalitis the lesions are most frequent in the basal ganglia, the locus niger and the medulla. They may occur in cases in which there is severe involvement in the cerebral cortex, and these are generally associated with involvement of the pia-arachnoid.

In rabbit encephalitis, the distribution of the lesions is the exact reverse. The cerebral cortex is most frequently involved and the meninges as well in the great majority of cases. One gets the impression that this is the site of origin of the disease and that the lesser lesions in the surrounding regions are due to a spreading from this point. Extending down the brain stem, the lesions become less frequent, being fairly common in the centrum ovale of the white matter, less so in the basal ganglions and comparatively rare in the medulla.

TYPE OF LESION

No description of the typical lesion in human encephalitis is necessary. In the rabbit, two types of lesion may be distinguished.

The first, and more common type, resembles exactly the lesion of the human disease and consists of an infiltration of the perivascular tissues of the smaller vessels with lymphocytes and plasma cells. The lesion in the meninges is also of this type, consisting at first of cellular infiltration limited to the region of the vessels and later spreading to fill diffusely the tissues with cells. Here again extension from the cortex beneath seems probable, as vessels with severe involvement may

be followed from the deeper regions in their course to the free surface, where the same lesion is found to a lesser degree. In the most severe cases the meningeal infiltration may be so marked that the pia is considerably thickened by the process, and this thickening may be increased also by a proliferation of fibroblasts and the formation of connective tissue fibrils in the more chronic cases.

The other type of lesion which is found in rabbit encephalitis, and which, when present, distinguishes it from the human disease, is the development of granulomatous nodules. These are found only in animals in which the disease is fully developed, and even in them it is limited in the majority of instances to regions in which the disease is farthest advanced, namely, the cerebral cortex. Occasionally they are found in the basal ganglia. Frequently in animals which are affected by the disease to only a mild degree, they are entirely absent, although the vascular infiltrations may be well marked.

The nodules vary in size from a cluster of a few cells to an area 0.5 mm. in diameter. They are made up principally of epithelioid cells, with an oval nucleus and a relatively large amount of deeply staining protoplasm. In the larger and apparently older nodules, the central portion of their protoplasm may show fatty degeneration and necrosis. In the most central portion of the nodule, the necrosis of the cells may be complete and so form a light staining area not unlike the caseous center of a tubercle. Nuclear débris and other products of granular degeneration are frequent in this region.

Scattered between the epithelioid cells are found lymphocytes, plasma cells and proliferating glia cells. Around the periphery of the nodule these elements, especially the proliferating neurologia, are even more numerous. In this region neuronophagy is also frequently observed.

The origin of the granulomatous nodule seems to be closely associated with the vascular lesion. This is shown by a study of its histogenesis. One can usually find early stages of its development when the nodule consists of only a few epithelioid cells. These lie in, and form part of, the wall of a small artery or capillary. It is difficult to decide whether these cells have arisen from the endothelium or from cells lying along the vessel wall, but the appearances noted would seem to indicate that the former is the case. As the nodule increases in size by the proliferation of the epithelioid cells and by the accumulation of lymphocytes and glia cells, the vessel is completely obliterated and disappears.

DIFFERENTIATION OF RABBIT ENCEPHALITIS AND EPIDEMIC ENCEPHALITIS BY THE MORPHOLOGIC CHANGES

From the description given above it is evident that rabbit encephalitis may be easily distinguished from epidemic encephalitis *provided the*

lesions are completely developed. Focal glia nodules do occur in the cortex of atypical cases of the human disease, but never are there true granulomatous lesions with central necrosis. The more diffuse glial proliferation seen in the chronic form of the human disease (Schaller and Oliver [5]) is not apt to be confused with these nodules.

The meningeal lesions in the rabbit are as a rule more marked than is found in the human disease, but the difference is one of degree and therefore easily subject to error of judgment.

The infiltrative lesions around the vessels are identical in the two conditions and cannot be distinguished from each other.

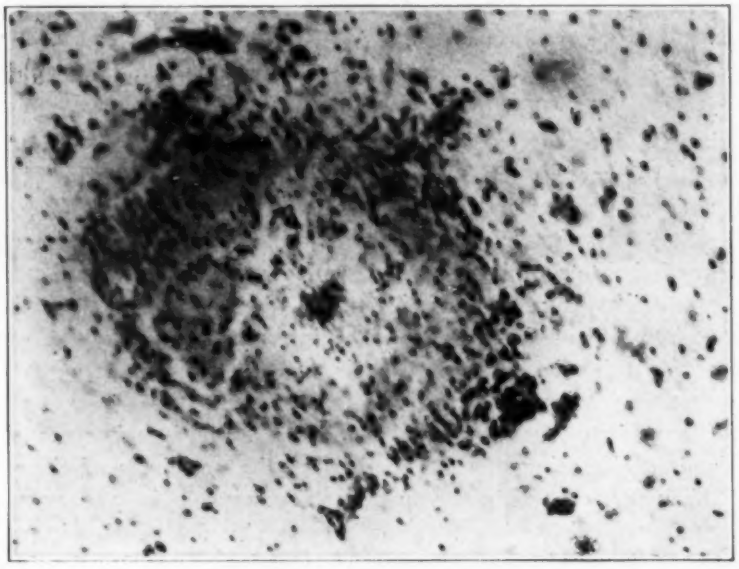

Fig. 1.—A granulomatous nodule in the cortex. In the necrotic center there is a large clump of parasites easily visible with low magnification.

Unfortunately, many animals, in our experience the majority, are only slightly affected by the disease and in them the only lesion present is the uncharacteristic perivascular infiltration. One could not say in these cases whether the lesion was the result of preexisting disease or the result of inoculation with some virus.

MICRO-ORGANISMS IN RABBIT ENCEPHALITIS

Micro-organisms have been described in the lesions of rabbit encephalitis by at least two groups of observers. Wright and Craighead [6] and

5. Schaller, W., and Oliver, J.: Chronic Epidemic Encephalitis, Arch. Neurol. & Psychiat. **8**:1 (July) 1922.

6. Wright, J. H., and Craighead, E. M.: J. Exper. Med. **36**:135, 1922.

Levaditi, Nicolau and Schoen [3] have observed in the brains and kidneys of such animals peculiar micro-organisms, which both interpret as most likely being protozoa. Wright and Craighead were also able to demonstrate them in the urine of animals and transmitted the disease to other animals by inoculation of nerve tissue. The resulting disease was of an acute character and resulted in paralysis of the animal's limbs.

Levaditi and his co-workers' description is essentially the same as that of Wright and Craighead. They observed the organism in the nerve

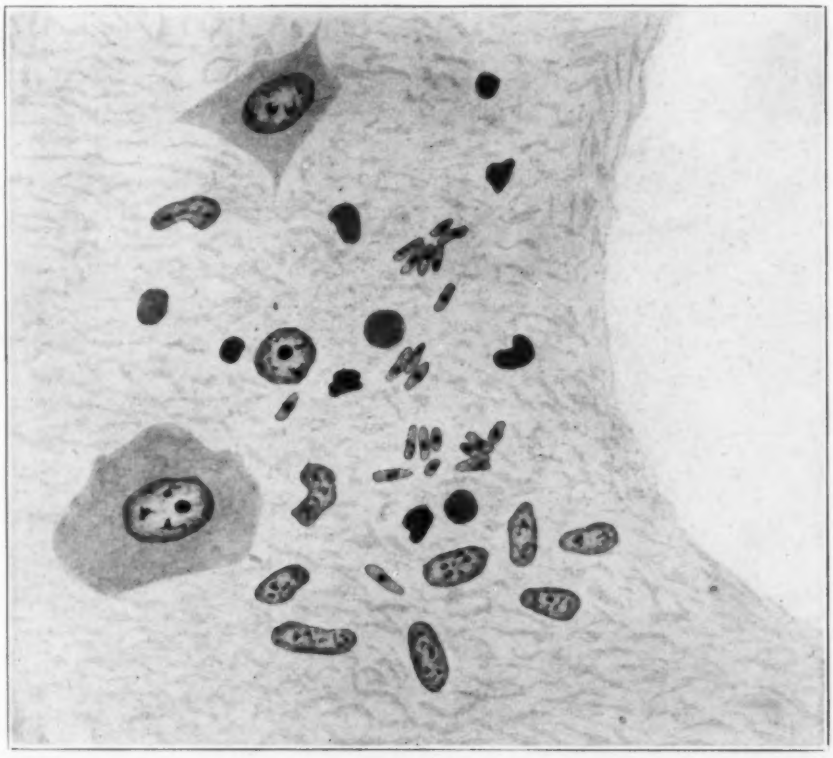

Fig. 2.—Central portion of a granulomatous nodule under oil immersion. At the right is a cavity formed by the destruction of the nervous tissue. In the surrounding tissue are many parasites with sharply cut cellular membranes and deeply staining protoplasmic granules.

tissue of rabbits suffering from the spontaneous disease and also in others affected with a similar condition supposedly produced by the inoculation of a virus originating from epidemic encephalitis. They have suggested the name of *Encephalitizoon cuniculi* for the parasite.

We have restudied our material in the light of these observations, and have found the organism present in the majority of the animals. We have available at the present time tissues from nine rabbits affected

by the disease, and the organism was found in seven. In order to save repetition we will not give the description of the previous investigators but describe the appearances noted in our specimens. This adds nothing new to their description, so that our findings are purely confirmatory.

The parasite is found in greatest number in the granulomatous lesions. In one case, the central necrotic portion was filled with a clump of organisms so large as to be visible with the low power lens (Fig. 1).

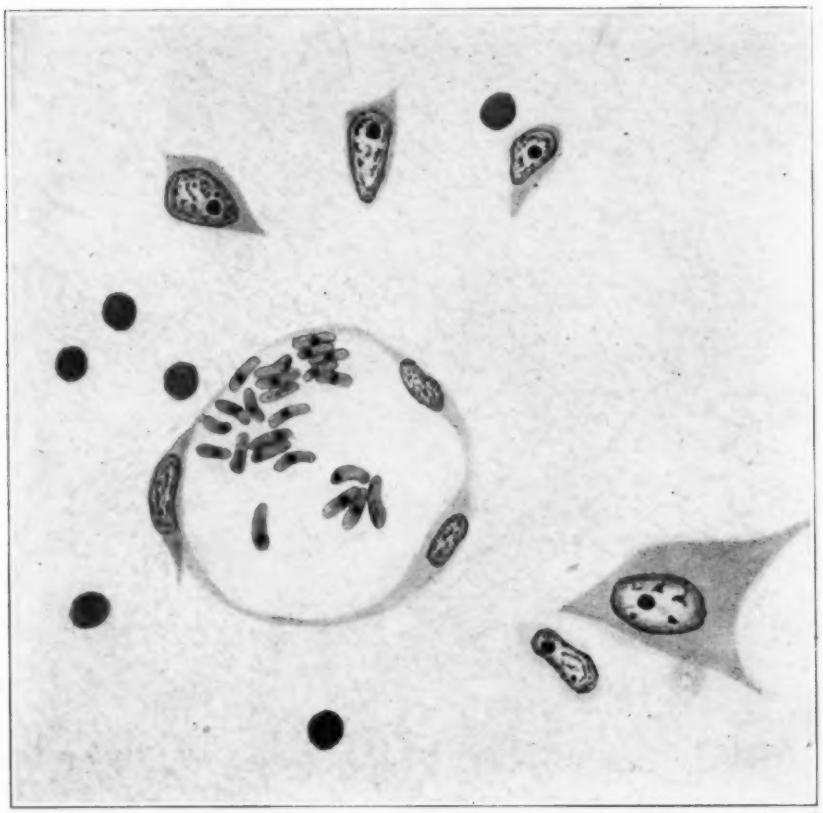

Fig. 3.—Small cavity lined with flattened cells and filled with parasites. This is an example of the structures considered by Levaditi to be cysts.

They stain well with the Giemsa stain but even better with Mann's method, as with this stain they appear a bright red in the blue background of the nerve tissue. They are oval or crescentic in shape, measuring about 2 by 4 microns (Figs. 2 and 3). They possess a deeply staining sharply cut external membrane, which encloses the protoplasmic mass of the organism. In some, this protoplasm has a diffuse homogeneous appearance, but in most there is a condensation of it to

form a deeply staining clump which is situated at one pole of the organism or in its center. No metachromatic chromatin could be found.

The organisms are found diffusely scattered throughout the central portion of the nodules, especially in the necrotic regions (Fig. 2). There is always, however, a tendency for them to be arranged in clusters, and in some instances they lie separated from the tissue of the nodule in a cavity lined by flattened cells (Fig. 3). This is the structure which Levaditi considers a cyst. They were not frequent in our specimens, and we were unable to decide as to their exact nature, although they appeared to be simply cavities formed by the destruction of the nerve tissue and surrounded by the proliferation of cells.

The frequency of occurrence of the organisms in different animals varied greatly. In one animal which showed the severe granulomatous stage of the disease they were present in enormous numbers in the nodules and easily found. In other animals which showed the vascular infiltrations only, a lengthy search was necessary to demonstrate them.

DISCUSSION

The presence of the parasite distinguishes the rabbit disease from epidemic encephalitis, and when found allows of no confusion of the two conditions. Levaditi was able by means of its demonstration to recognize the true nature of one strain which has been transmitted through several generations of rabbits and which had been considered due to virus from a human case.

It now becomes necessary to examine critically the material from all the experiments which have supposedly demonstrated the transmission of the disease from man to rabbits, and it is possible that with our additional knowledge of the characteristics of the two conditions there will be some illumination of the present confusion.

CONCLUSION

1. Rabbit encephalitis differs from the human disease in the type of lesions produced.

2. The differences are well marked only in completely developed cases of the former.

3. Rabbit encephalitis is further distinguished by the presence of an organism whose exact nature we have been unable to determine.

Clinical and Occasional Notes

OPTIC NEURITIS AND CHOKED DISK IN INFLUENZA

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TOPEKA, KAN.

That inflammation of the optic nerve may be associated with influenza is definitely shown by the literature. But whether the optic neuritis is infectious, toxic or mechanical is uncertain. In the case here reported, apparently there was an acute hydrocephalus and one might conclude that the optic neuritis was due to increase of intracranial pressure, but it seems much more probable that the optic neuritis was a local acute inflammatory reaction to a toxemia which also produced the hydrocephalus and perhaps a more general low-grade encephalitis.

REPORT OF CASE

In September, 1918, influenza was widespread in Boston. L. F., a Jewess, aged 29, was taken acutely ill on September 14, with headache, malaise, chills and fever. The fever was never over 102 F., and lasted only four or five days, but there was marked prostration and she was still in bed at the end of two weeks when seen by Dr. Myerson, although there had been no lung involvement. As the temperature had fallen to normal at or before the end of the first week, intense pain in the head had been complained of and there were evidences of "considerable restlessness, anxiety and a little confusion." When seen by Dr. Myerson, the headache, clearly distinguished from the preceding influenza headache, was very severe and there was repeated vomiting. The confusion and excitement had increased. There was much yawning, and twice the relatives thought she was unconscious for a short period.

Examination showed increased reflexes with questionable stiffness of the neck. Spinal fluid (20 c.c. removed) was under pressure, clear, contained about nine lymphocytes, and was chemically negative. The puncture relieved the headache. "There was a moderate degree of optic neuritis."

She was admitted to the Boston Psychopathic Hospital September 29. The family and personal histories were unimportant. The results of physical neurologic and mental examinations were negative. The spinal fluid was not reexamined. She was adjudged not psychotic and was discharged on the tenth day.

On the fifth day of the illness acute bilateral optic neuritis developed; papilledema of not more than two diopters. The retina surrounding the nerve was much inflamed and the outline of the nerve head was obliterated. During her stay in the hospital the headaches subsided, being replaced by a throbbing sensation. At first she complained bitterly and, when admitted, made considerable stir, but this was attributed to her temperament.

Dr. Myerson writes that after discharge from the hospital, lumbar puncture, performed three times, always showed normal fluid. The head discomfort dis-

appeared in about a month. Vision, not accurately tested by an oculist, was considerably impaired and improved very slowly. A year afterward, however, it was found practically normal. Since, the patient has been lost sight of.

REVIEW OF LITERATURE

Examples of optic neuritis and neuroretinitis in association with influenza were collected by G. Blin [1] in 1905. He gives Bergmeister [2] credit for having first pointed it out, but it was mentioned in that same year by at least eight others: Delacroix,[3] Braunstein,[4] Hansen,[5] Galezowski,[6] Remak,[6] Stoewer,[7] Vignes [8] and Landesberg.[8] In 1891 accounts were contributed by Mme. Pokitonoff,[9] MacNamara,[10] Lebeau,[10] Neurer [6] and Weeks [11] and in 1892 Antonellie [6] reported two cases, Berger [6] one case. Burnett [6] reported seven cases (1893) and Henberg [6] (1895) observed neuritis, atrophy and paralysis of accommodation. In 1899, Fleming [6] reported a case of retinochoroiditis; Despagnet,[6] a case of atrophy; Parinaud,[6] neuritis; Wingenroth,[6] three cases of acute neuritis. In 1900, Kopff [6] reported a case of double optic neuritis, with mydriasis following recovery.

In 1902, Natanson [12] reported the case of a girl, aged 17, who lost the sight of one eye after influenza. Prothon [13] (speaking of ocular affections) says: "The most frequent of the influenzal alterations is neuritis, which is manifested in a form of retro-bulbar neuritis or papillitis." He considers the toxic-infectious theory as the only one capable of explaining the lesions which he describes. Congestion and decoloration of the papilla are the most constant findings.

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1. Blin, G.: Etude des manifestations oculaires de la démence précoce, Thése de Paris, 1904-1905.
2. Bergmeister: Intern. klin. Rundschau; abstracted in Rev. gén. d'opht. **9**:335, 1890.
3. Delacroix: Complications oculaires de l'influenza, Rheims, 1890.
4. Braunstein: Westnik Ophthalm., Nov.-Dec., 1890, translated in Rev. gén. d'opht. **10**:184, 1891.
5. Hansen: Nord. opthalmol. Titsskr. **3**:2.
6. Quoted by Blin, Footnote 1.
7. Stoewer, Soc. de méd. de Nancy, April, 1890.
8. Landesberg: Centralbl. f. Augenh., 1890.
9. Pokitonoff, Mathilde: Contribution à l'étude des complications oculaires de l'influenza, Paris, 1890.
10. MacNamara, C. N.: A Manual of Diseases of the Eye, London, Churchill & Sons, 1868, p. 571.
11. Weeks: La Grippe as a Cause of Retrobulbar Neuritis and Other Ocular Nerve Lesions, New York M. J. **54**:143 (Aug. 8) 1891.
12. Natanson, A.: Ein Fall von Influenza mit Pleuropneumonie und doppelseitiger Iridochoroiditis embolica, St. Petersburg. med. Wchnschr. **7**:213 (June 16) 1890.
13. Prothon: Névrite optique d'origine variolique, Lyon méd. **94**:128, 1900. Des lésions du fond de l'oeil dans les infections générales aigues, Lyon, 1900.

Lyle [14] (1907) wrote that "optic neuritis, which is probably a descending neuritis, may . . . occur during an attack of influenza" and the same year Thilliez [15] reported a case of double optic neuritis occurring five days after an attack of influenza in a woman aged 35. Vision slowly improved in one eye but the other remained blind from optic atrophy. Moustakas [16] reported a case of influenzal optic neuritis and concluded that it differs from nicotin or alcoholic neuritis in attacking the two eyes successively rather than simultaneously. Sameh Bey's [17] patient was a woman, aged 30. On the tenth day of influenza vision of the left eye gradually diminished, the disk was congested, bright red, and covered with a grayish white infiltration. The veins were engorged and infiltrated in places. The right eye was normal. After administration of antidiphtheric serum the patient improved rapidly and vision was soon restored.

I have found nothing more in the literature until 1916, when Knapp [18] described bilateral optic neuritis in a woman, aged 32, with a star-shaped figure around the macula resembling that found in albuminuric retinitis (except that in albuminuric retinitis the figure is much less delicate and less silvery). In influenzal retinitis the figure resembles that sometimes found in optic neuritis associated with brain disease. The optic neuritis ran the usual course, as is seen in influenza cases. There was slow improvement, uninfluenced by treatment. The optic neuritis in this case was caused by a hematogenous infection which at the same time produced a slight toxic reaction in the cerebrospinal fluid.

Of eye affections in the influenza epidemic of 1918-1920, much less has been written. The Germans seem to have considered the matter more carefully than others; British writers next. No French literature was found. R. Hessberg,[19] quoting from an abstract in *The Journal of the American Medical Association,* reported on the basis of special investigations that a great many diseases of the eye were noted following the influenza epidemic of 1918-1919. Disease of the cornea was especially severe, although the prognosis was favorable. Affections of the uvea had a less favorable outcome, for the reason that the intoxication was evidently more severe.

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14. Lyle, H. W.: Ocular Manifestations Accompanying Influenza, Practitioner **78**:101, 1907.

15. Thilliez: Double Optic Neuritis Following Influenza, J. d. sc. méd. de Lille, **2**:385 (Oct. 26) 1907.

16. Moustakas: Névrite optique grippale, Rev. d'opht. **30**:163, 1908.

17. Sameh Bey: Névro-rétinite grippale guérie par le sérum antidiphtérique, Clin. opht. **15**:255, 1909.

18. Knapp, A.: Optic Neuritis After Influenza, with Changes in Cerebrospinal Fluid, Arch. Ophth. **45**:247 (May) 1916.

19. Hessberg, R.: Eye Disease Following Influenza, München. med. Wchnschr. **67**:207 (Feb. 20) 1920; abstracted in J. A. M. A. **75**:709 (Sept. 4) 1920.

E. Fraenkel [20] contributed two articles in regard to eye disease. Of 132 cases of influenza he found eye involvement in forty-six, which he thinks is a larger percentage than is found in any other acute infection in the latitude of Germany. Both eyes were not always involved. Hemorrhagic conditions were the most common. Hemorrhage of the retina gradually abated and finally disappeared. Microscopic examination of hemorrhagic foci in the retina revealed that the hemorrhage was not accompanied by inflammatory processes. There was no evidence that the changes in the retina were due to invading bacteria.

Urbantschitsch [21] contributed an article in the same year on "Intermittent Choked Disk and Abducens Paralysis with Influenza or Epidemic Encephalitis." The probability of his case being one of the latter disease excludes it from consideration here because it is well known that choked disk is relatively frequent with epidemic encephalitis.

In England, Denyer [22] has carefully reported a typical case (1922).

"The patient, a young woman, aged 17, was, during convalescence from influenza, attacked with papillitis, which was accompanied by blindness of rapid onset and frontal and temporal pain. The sight was gradually recovered in the course of three or four weeks. There was no evidence of cerebral tumour or abscess, or of syphilis, and the Wassermann reaction of the cerebrospinal fluid was negative. . . . .

"The history was that three weeks before admission she was taken ill with influenza, and was in bed for one week. There was no cough. A week later her eyes and eyelids hurt her, and 'a dark mist came over her eyes.' She could not see to read in bad light or good. In the ward we found that she was blind in the right eye, with no perception of light. With the left eye she could see fingers at one foot. On ophthalmoscopic examination there was marked optic neuritis (papillitis) of both eyes. She had a headache (frontal and left temporal region) which had lasted fourteen days. . . . .

"January 9th. No headache; can see hand with right eye.

"January 10th. Sees fingers with right eye at two feet; with left eye at seven feet. No headache; is taking food well. There was now no tension on hamstrings; no ankle clonus; no anaesthesia, no incoordination; knee-jerks normal; optic neuritis was still present (oedema of disks).

"January 11th. No headache; vision the same; 10 c.c. clear cerebrospinal fluid withdrawn by lumbar puncture was negative to Wassermann test.

"January 13th. Blood pressure 95 mm. hg.; optic disks slightly improved. Pneumococcic vaccine 1 million given.

"January 20th. Ophthalmic surgeon's report: She can now read ordinary print; optic disks nearly normal. Right fundus veins dilated, otherwise nearly normal. Left fundus, disk normal. There was no albumin in the urine. Blood pressure, 102 mm. hg.

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20. Fraenkel, E.: Eye Disease Associated with Influenza, Deutsch. med. Wchnschr. **46**:673 and 1182 (June 17 and Oct. 21) 1920; abstracted in J. A. M. A. **76**:624 (Feb. 26) 1921.

21. Urbantschitsch: Wien. klin. Wchnschr. **33**:166 (Feb. 19) 1920.

22. Denyer, S. E.: Blindness as an Immediate Sequela of Influenza: Recovery, Brit. M. J. **1**:223 (Feb. 11) 1922.

"January 23rd. Can read without pain or headache; she feels quite well; oedema of legs and albumin have disappeared.

"January 27th. She feels quite well, and is getting up. The thalmic surgeon reported: Slight swelling of right optic disk and veins moderately dilated. R. V. 6/24; with — 1 cyl., axis 90, vision equals 6/18. Left eye: Fundus normal, vision 6:12; emmetropic. In the ward she was found to be able to read ordinary small print quite well, in not too good a light. She stated that she felt nothing wrong with her head."

Gardner [23] reported a man with paraplegia and optic neuritis but the case was probably one of encephalitis. Aitken [24] reported from South Africa the case of a man with a history of blindness following influenza. Examination proved to be of therapeutic value and, disregarding considerations of psychotherapy, Aitken concluded that the blurring was "exaggerated" by a ciliary muscle weakness. The case was not one of neuritis. From Italy, Puccioni [25] wrote, in 1906, of "acute retrobulbar neuritis with influenza."

On this side of the Atlantic the most recent contribution is from Fernandez [26] of Havana. Among his hundreds of influenza cases he encountered only six in which there was iritis from toxic action, or in which the optic nerve and papilla or the angle of filtration were suffering from the same toxic action. The patients were all men between 19 and 40, and four recovered under the usual local measures. One patient was left with incipient atrophy of the optic nerve, and in another patient the choked disk accompanying sinusitis only partially retrogressed. Brown [27] reported a case, in 1918, and Stieren,[28] contributed a general discussion, in 1919.

CONCLUSIONS

Optic neuritis with papilledema, usually bilateral, has been observed frequently in association with typical influenza. It is usually noticed immediately after the subsidence of the acute symptoms, manifested chiefly by headache and blurred vision, but with other minor symptoms in variety. It is striking that by far the majority of reported cases have occurred in women, nearly all of them in the fourth decade.

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23. Gardner, H. W.: Three Cases of Paraplegia Following Influenza, Lancet **1**:1003 (May 19) 1923.

24. Aitken, C. J. H.: Blindness Following Influenza, Brit. M. J. **1**:311 (Feb. 25) 1922.

25. Puccioni, G.: Nevrite retrobulbare acuta da influenza, Bull. d. r. accad. med. di Róma **32**:311, 1906.

26. Fernandez, F. M.: Ocular Complications of Influenza, Cron. med.-quir., Habana, **45**:232 (Aug.) 1919.

27. Brown, E. J.: Retrobulbar Neuritis Following Influenza, Am. J. Ophth. **1**:498 (July) 1918.

28. Stieren, E.: Ocular Lesions in Influenza, Am. J. Ophth. **2**:55 (Jan.) 1919.

Apparently the prognosis is good; most cases have made a complete although slow recovery; a few have been rendered permanently blind in one or both eyes with optic atrophy. Therapeutically, lumbar puncture is certainly indicated; it is followed by immediate subjective relief, and the improved mechanical conditions resulting surely improve the prospects for speedier subsidence of the neural lesion.

Mulvane Building

Abstracts from Current Literature

GROUP PSYCHOLOGY AND THE ANALYSIS OF THE EGO. SIGMUND FREUD, Translation by JAMES STRACHEY, Internat. Psychoanalyt. Library, No. 6, 1923.

In this closely written book Freud enters the lists with the herd psychologists. His opening sentence disparages the distinction between individual and group psychology, and the rest of the book is an application of his well known individualistic psychology to phenomena commonly regarded as within the realm of social psychology, herd psychology, or group psychology. In the mental life of any individual some one else is invariably involved and hence the distinction is primarily one of the attitude of the examiner, and one of pragmatic rather than intrinsic value.

Freud's thesis is briefly this: The force which operates to hold together a crowd is a special form of the same libido which operates so powerfully in all human relationships, love. In herd or group manifestations from the psychologic standpoint there are phenomena of libido transference similar and comparable to those of hypnosis and of romantic love affairs, or infatuation. What occurs in all three of these situations is that a certain love attitude is taken by the subject toward the object; the nature of this bond and the way in which it differs in the various states mentioned (crowd, hypnosis, infatuation) are carefully elaborated in the text. In a word, the similarities have to do with the mechanisms of object love and identification, and the distinctions depend on the suppression or repression of sensual phases with replacement by sublimations. As is usual with Freud's contributions, the main thesis is developed with many valuable corollaries and digressions, the details of which, together with an epitome of the argument, are presented herewith.

He begins with a review of Le Bon's "deservedly famous work, The Crowd." In this he thinks is best presented a range of the phenomena under review from which to select the characteristic data. From this data he would answer: (1) What is a psychologic group? (2) Whence its great power? (3) What is the nature of the mental change which it effects?

Freud begins with the third, answering by quoting Le Bon. He quite gleefully includes in his quotation this tribute to his own point of view: "Behind the avowed causes of our acts there undoubtedly lie secret causes that we do not avow, but behind these secret causes there are many others more secret still of which we ourselves are ignorant. The greater part of our daily actions are the result of hidden motives which escape our observation." In a group these secret motives are apparent because of the obliteration of individual superficialities and distinctions. "The racial unconscious emerges; what is heterogeneous is submerged in what is homogeneous."

In addition to this, however, Le Bon believed that new characteristics appeared; developing, first from the sense of invincible power derived from numbers, secondly from contagion, and thirdly from suggestibility. Summarized, then, Le Bon conceives of the individual in a crowd as being characterized mentally by the "disappearance of conscious personality, the predominance of the unconscious personality, the turning, by means of suggestion and contagion, of feelings and ideas in an identical direction, and the tendency to immediately transform the suggested ideas into acts."

This Freud points out is actually a hypnotic state. He makes certain objections to the analogy and also to the argument. He points out that contagion and suggestion may be parts of one another rather than coordinates; he does not think the effects of the two as separately considered are sharply differentiated by Le Bon, and he points out that the person replacing the hypnotist in the case of the group is not mentioned by Le Bon.

Reverting now to the first question, Freud collects the descriptive characteristics of a crowd, of which he interpolates that there is "not a single feature which a psychoanalyst would find any difficulty in placing or in deriving from its source." Thus a group is "impulsive, changeable, irritable . . . led almost exclusively by the unconsciousness . . . generous or cruel, heroic or cowardly . . . unpremeditated . . . incapable of perseverance . . . intolerant of delay . . . has a sense of omnipotence . . . extraordinarily credulous . . . without critical faculty . . . thinks in images . . . knows neither doubt nor uncertainty . . . goes directly to extremes . . . is excited only by an excessive stimulus . . . minus all individual inhibitions . . . fundamentally entirely conservative . . . subject to most contradictory ideas . . . and to the truly magical power of words . . . and (finally) has never thirsted after truth but demands illusions."

Le Bon ascribes both to the ideas and to the leaders of a group a mysterious and irresistible power which he calls prestige. This Freud thinks is very inadequate, and he thinks that Le Bon's treatise is weakest at this point. He opens his third chapter, however, with other objections to Le Bon. "Everything he says to the detriment and depreciation of the manifestations of the group mind had already been said by others before him with equal distinctness and equal hostility and has been repeated in unison by thinkers, statesmen and writers since the earliest periods of literature." Sighele antedated Le Bon in his two most important opinions, "those touching upon the collective inhibition of intellectual functioning and the heightening of affectivity in groups." But the fact is that all these data are by no means undisputed. For even Le Bon admits the morals of a group are sometimes higher than those of its constituent individuals and that while to be sure the best intellectual work, great decisions and momentous discoveries, are only possible to an individual in solitude, the group mind is nevertheless capable of genius in intellectual creation, shown by language itself, by folk song, folklore, etc. And how much credit shall we give to it for the stimulation it affords the individual?

McDougall's "The Group Mind" is then reviewed. McDougall thinks that "intensification of emotion" is the most important result of a group, based on "some degree of reciprocal influence" with a similar emotional bias. The group then for the moment replaces the whole of human society which is the wielder of authority and punishment and in obedience to the new authority the individual develops new scruples to replace the old; a clue to the mystery of suggestion.

The fourth chapter starts out with a barrage on the older conceptions of suggestion. The various synonyms used by various authors are quoted with the hypothetical conclusion that suggestibility is an irreducible mental phenomenon. This was the opinion of Bernheim under whom it will be recalled Freud worked in 1889 and as a protest to whose dogmatism Freud conceived of a further resolution of the phenomenon of suggestion. Why should the explanation of all these cures and effects be itself immune from explanation?

To this explanation Freud applies the libido concept. "Libido is an expression taken from the theory of the emotions. We call by that name the energy (regarded as a quantitative magnitude, though not at present actually mea-

surable) of those instincts which have to do with all that may be comprised under the word 'love.' The nucleus of what we mean by love naturally consists (and this is what is commonly called love, and what the poets sing of) in sexual love with sexual union as its aim. But we do not separate from this—what in any case has a share in the name love—on the one hand self-love, and on the other, love for parents and children, friendship and love for humanity in general and also devotion to concrete objects and to abstract ideas. Our justification lies in the fact that psychoanalytic research has taught us that all these tendencies are an expression of the same instinctive activities; in relations between the sexes these instincts force their way toward sexual union, but in other circumstances they are diverted from this aim or are prevented from reaching it, though always preserving enough of their original nature to keep their identity recognizable (as in such features as the longing for proximity, and self-sacrifice).

"We are of the opinion, then, that language has carried out an entirely justifiable piece of unification in creating the word 'love' with its numerous uses, and that we cannot do better than take it as the basis of our scientific discussions and expositions as well. By coming to this decision, psychoanalysis has let loose a storm of indignation, as though it had been guilty of an act of outrageous innovation. Yet psychoanalysis has done nothing original in taking love in this 'wider' sense. In its origin, function, and relation to sexual love, the Eros of the philosopher Plato coincides exactly with the love force, the libido, of psychoanalysis, as has been shown in detail by Nachmansohn and Pfister; and when the Apostle Paul, in his famous epistle to the Corinthians, prizes love above all else, he certainly understands it in the same 'wider' sense. But this only shows that men do not always take their great thinkers seriously, even when they profess most to admire them.

"Psychoanalysis, then, gives these love instincts the name of sexual instincts, *a postiori* and by reason of their origin. The majority of 'educated' people have regarded this nomenclature as an insult, and have taken their revenge by retorting upon psychoanalysis with the reproach of 'pan-sexualism.' Anyone who considers sex as something mortifying and humiliating to human nature is at liberty to make use of the more genteel expressions 'Eros' and 'erotic.' I might have done so myself from the first and thus have spared myself much opposition. But I did not want to, for I like to avoid concessions to faint-heartedness. One can never tell where that road may lead one; one gives way first in words, and then little by little in substance too. I cannot see any merit in being ashamed of sex; the Greek word 'Eros,' which is to soften the affront, is in the end nothing more than a translation of our German word Liebe (love); and finally, he who knows how to wait need make no concessions.

"We will try our fortune, then, with the supposition that love relationships (or, to use a more neutral expression, emotional ties) also constitute the essence of the group mind. Let us remember that the authorities make no mention of any such relations. What would correspond to them is evidently concealed behind the shelter, the screen, of suggestion. Our hypothesis finds support in the first instance from two passing thoughts. First, that a group is clearly held together by a power of some kind; and to what power could this feat be better ascribed than to Eros, who holds together everything in the world? Secondly, that if an individual gives up his distinctiveness in a group and lets its other members influence him by suggestion, it gives one the impression that he does it because he feels the need of being in harmony with them rather than in opposition to them—so that perhaps after all he does it *'ihnen zu Liebe.'*"

After this very characteristic and very brilliant charge Freud settles himself to a consideration of two artificial groups, the church and the army, communities of believers and of fighters held together by a certain external force, hence artificial, both with a head who supposedly loves all the individuals in the group with an equal love. "Everything depends upon this illusion." It is a fundamentally proper thing that Christians call each other brothers. They are bound one to another by libidinal ties just as they are also to the leader. The bond is one of cathexis, which the translator explains in a footnote to have been derived from the Greek word meaning "I occupy," and having reference to the concentration or accumulation of mental energy in some particular channel like an electric charge, and usually having the idea of establishing a certain relation, as for example of an individual with an object. This would be spoken of as an object cathexis and mean a direction of libido toward that object or infusion into it.

When this cathexis breaks down the phenomenon of panic is observed; "The mutual ties have ceased to exist and the gigantic and senseless dread (Angst) is set free." The dread of this dread is the basis of religious intolerance. "However difficult we may find it personally we ought not to reproach believers too severely on this account (cruelty and intolerance to outsiders); people who are unbelieving or indifferent are so much better off psychologically in this respect." If the intolerance is less violent today, Freud says, it is not that we are softer hearted, but that religious bonds are weaker, perhaps to be replaced by another tie, such as the socialistic (or, the reviewer would suggest, the nationalistic movement, as illustrated by the fascisti and the Ku Klux Klan) in which case "there will be the same intolerance toward outsiders as in the age of the Wars of Religion."

In the next chapter under "Further Problems and Lines of Work" Freud takes up the nature of emotional relationships existing between men in general and discusses the ambivalent nature of the bond between any two persons of close relationship. In addition to the love there is "the sediment of feelings of aversion and hostility which have first to be eliminated by repression." This theme Freud elaborated in his recently published work "Beyond the Pleasure Principle," in which the polarity of love and hatred are linked with the instincts of life and death. Now these negative feelings, which are scarcely ever completely repressed in ordinary dual relationships, are entirely repressed as the result of the formation of a group, for the individuals of that group, and all intolerance vanishes. Self-love is quite overcome by object-love. But this object-love in part is determined by *identification*, a phenomenon to which the seventh chapter is devoted.

This mutual tie of love between members of a group is subjected to analysis with the idea of determining how much of it is entirely detached "object-cathexis" and how much of it the simpler form of emotional expression known as identification. Identification is the ambivalent emotional bond which consists in the wish to be like the beloved, that is to take him for the ideal, and at the same time to displace him. Identification then takes the object as that like which it would fain be (i. e., become) and object-cathexis takes the object for what it would like to have. Between these two types of emotional bondage there is conflict, so that in some neuroses for example identification displaces object choice, or in other words object choice regresses to identification.

Freud summarizes the rather ambiguous discussion of the next six pages by saying that identification then is the original form of emotional tie with an object; secondly, in a regressive way it becomes a substitute for a libidinal

object tie (which, as Freud does not make clear, evidently assuming that everyone understands it, is the reverse of the usual progressive development of libido). Thirdly, it may arise with every new perception of a common quality shared with some other person who is not an object of the uninhibited sexual instinct.

To elucidate this Freud cites four examples from psychanalytic research of conflict and interrelation between object-cathexis and identification. Two examples with bad results are male homosexuality and melancholia. Two examples with good results are the state of being in love, and hypnosis.

These illustrations, particularly the first two, are in a sense a digression or at least a very discursive illustration, but they are important to psychanalytic and psychiatric theory. It is unfortunate that Freud outlines his thesis so vaguely.

Male homosexuality, he says, originates very often as follows: A young man has been unusually long and intensely fixated on his mother "in the sense of the Oedipus complex." When the time comes for exchanging his mother for another sexual object he does not abandon her but, regressing, identifies himself with her, transforms himself into her, is she, "and now looks about for objects which can replace his ego for him and on which he can bestow such love and care as he has experienced from his mother."

In melancholia, the second example, often as a result of the real or emotional loss of a loved object there develops a cruel self-depreciation of the ego, relentless and bitter self accusation, and reproach and criticism. These disparagements have been found to apply really to the object that has been lost and represent the ego's revenge on it. "It" has by identification become the ego; the object has been introjected into the ego; or, as Freud likes to express it, "the shadow of the object has fallen upon the ego." Moreover the ego has been divided and one of its parts wars against the other. This other part is the one which has been altered by introjection and which contains the lost object. The first part, the cruel part, is the conscience, the critical faculty of the ego, active in normal times but never so relentlessly and unjustifiably. It is the *ego ideal,* a name by which Freud wishes to indicate the chief agency in repression, having as its faculties self-observation, moral conscience, dream censorship and repression. As heir to the original self-love of the child appropriately modified by the environmental demands, the ego ideal is able to satisfy the aspirations of a defeated ego, or at least an ego which has not been able to meet all the environmental demands, which of course no ego ever is.

Being in love, the third example, Freud introduces with one of the several epigrams scattered through the book. "Even in its caprices the usage of language remains true to some kind of reality." Loving is used in many senses but with one element of meaning common to all. Being in love may be simply object-cathexis "on the part of the sexual instincts with a view to direct sexual satisfaction" (Freud uses the word instincts loosely here I think), one which expires with its aim accomplished. This is ordinary sensual love. Back of this there is a motive which does not expire, the same motive that stimulated it in the first place. This motive is the parentally directed love of childhood, the infantile aim having been repressed with the renunciation of these objects for others, but the repressed ("zielgehemmte") instincts remain, modified by the repression, to be described as "tender" instead of sensual, although the sensual nature persists in the unconscious.

From the conflicts of this metamorphosis as it takes place in puberty there arise the various types of lovers. There is the type manifesting sentimental

enthusiasm and respect for women who fail to excite him sexually, his sexual potency being reserved for women whom he does not love or even despises. The second type is the result of a compromise or synthesis between the heavenly and the earthly love, the repressed and the unrepressed, and his relations to women are characterized by an interaction (and alternation, I think Freud intended to intimate) of these love modes. Finally there is the third type (implied, not described by Freud) in which the inhibited instincts of love, manifested as tenderness, are obliterated by the purely sensual manifestations.

Idealization of the love object, the basis of the adage that love is blind, is explained by the fact that part of this love is a flow of narcissistic libido. The love object often serves as an ego ideal. "We love it on account of the perfections which we have striven to reach for our own ego and which we should now like to procure in this roundabout way as a means of satisfying our narcissism." The object may even consume the ego; it may replace the ego ideal.

The distinction between identification and infatuation is that in the former the ego takes unto itself the object (introjection); in the latter the object depletes the ego with a hypercathexis (on the part of the ego). The question then arises as to whether the object is put in the place of the ego or of the ego ideal. In a sense this restates the distinction between identification and infatuation.

"From being in love to hypnosis is evidently only a short step." They are alike in having the same subjection and uncritical compliance toward an external object. There is the same absorption of initiative, the same unification of attention. The hypnotist has occupied the ego ideal. The distinction between hypnosis and infatuation is that in the former love relation sexual satisfaction is excluded, in the latter it is only temporarily held back.

This is Freud's bridge into the conclusion at the heart of this book, namely, that the hypnotic relation is a group formation with two members, with the behavior of the individual to the leader isolated. In other words there are these three states of love: infatuation, hypnosis, crowd. A crowd or group then is "a number of individuals who have substituted one and the same object for their ego ideal and have consequently identified themselves with one another." (Freud adds "in their ego," meaning with one another's ego.)

Freud concedes as yet unexplained the manner in which hypnosis is produced, the reason why some are so much more susceptible to it than others, the element of paralysis and the remnant of moral conscience in spite of otherwise complete compliance.

Trotter is considered in the next chapter, on "The Herd Instinct." In view of the excellence of the first half of Trotter's book, and the bitter smallness of the second half, Freud's graciousness is magnanimous: "A thoughtful book, . . . concerning which my only regret is that it does not entirely escape antipathies that were set loose by the recent great war."

Trotter, it will be recalled, believed that herd instinct is irreducible, and that from it were derived the forces of repression. Freud thinks that he gives too little consideration to the leader's part and also doubts the irreducibility of herd instinct. He takes up certain details of this refutation. He sees in the *esprit de corps* of a crowd the derivations of envy, each member denying himself in order that others may be unable to have them or to ask for them, a demand for equality which "is the root of social conscience and the sense of duty." Illustrating this is the syphilitic's dread of infecting other people which psychanalysis has related to a violent struggle against the unconscious wish to spread their infection not only from revenge but from a feeling that all should suffer alike. Freud recalls the judgment of Solomon in regard to the two babies

—"the bereaved woman was recognized by this wish." In other words, there is a reversal of a hostile feeling in the interests of a positive feeling toward each other by identification. They want to be equal to one another, all ruled by one person. Man is not a herd animal but a horde animal, an individual creature in a horde led by a chief. This, of course, was Darwin's theory of the primitive form of human society, a point previously elaborated in Freud's "Totem and Taboo," to the effect that totemism and other religious origins are concerned with the killing of the chief and the transformation of the horde to a community of brothers. This primal horde is revived in the group and as primitive man survives in the individual so the primitive horde survives in the crowd. At first man was a superman; later love put a check on narcissism and became a factor in civilization. The primal mortal father was replaced by a son when dead and became immortal by deification. This son had been an individual, and here is the link between individual and group psychology. Prior to his death the father had kept the sons down, had forced them into abstinence in order to hold the emotional tie with him. His sexual jealousy and intolerance then forced his sons into the group psychology. Church and army are an idealistic replica of this state.

Freud further relates the position of a father to that of the Godhead, the great leader, the being possessed of manna, and finally, also to the hypnotist. He calls attention to Ferenczi's point that hypnosis may be induced by the maternal method of coaxing, soothing, or by the paternal method of command or threat. (Ernest Southard used to refer to these as the *manière douce* and the *manière forte*. Southard would have pointed out that this is another form of the eternally recurring, active and passive voice.)

The suggestibility of the individual then depends on the persistence of the archaic attitude of compliance toward the parents with roots in the racial unconscious where individuals stood in the same relation to a primal father, and suggestion may be as "a conviction which is not based upon perception and reasoning but upon an erotic tie."

The disparity between the ego and the ego ideal is a variable function; in some it is slight and this greatly facilitates the selection of a leader; it gives him both a human touch and a divine effulgence as it were, the self complacency of youth. Identification and through it suggestion swing into line those whose ego ideals would not otherwise coincide. This differentiating grade in the ego was elaborated by Freud in his paper "Zur Einfuehrung des Narzissmus." The ego may be the object of the ego ideal. These mental differentiations aggravate the difficulties of mental functioning, increase its instability and are the starting points of disease. Being born is such an epoch when an entire readjustment is necessary by reason of the change in environment. We periodically revert to this previous stage of self sufficient narcissism, by going to sleep and also in dreams, neurotic symptoms, wit and humor which express circumventions of the repressed unconscious. But this is not enough. There must be occasional periodic suspensions of the repressed shown by the institution of festivals, carnivals and the equivalent periods of legalized escape in the individual life corresponding to these racial customs. The ego ideal comprises all the limitations in which the ego has to acquiesce and therefore to abrogate the ideal constitutes a magnificent release for the ego which may then once again feel satisfied with itself. The sense of guilt and of inferiority are an expression of tension between the ego and the ego ideal. Alternation of these states is seen in the cyclothymic. In mania the ego and ego ideal are fused; in melancholia they are too widely separated, with a rebellion of the ego against the ego ideal.

This is the end of the book proper. A postscript is added (Chapter 12), however, which continues the line of thought, taking up certain digressions. First the point is made that, while in the army the commander stands in relation to the soldier as the identification of the ego with an object, in the Catholic church there is a replacement of the ego ideal by an object as well as identification with fellow Christians. A soldier identifies himself with his comrades but not with his leader. A Christian not only identifies himself with his comrades but also with Christ, the leader, thus supplementing the ordinary mechanism of group formation.

A note derived from a conversation with Otto Rank is concerned with the invention of the heroic myth, the hero being a man who had slain the father (the totemistic monster) and become the leader. The poet who first conceived this epic is picturing in the hero's deeds his own wishes, lowering himself to the level of reality and raising his hearers to the level of imagination. They, too, understand and identify themselves with the hero. The murdered father is then deified.

A third note concerns the distinction between direct sexual instincts and those inhibited in their aims. Here Freud recapitulates his theory of repression, using as an example the Oedipus complex and pointing out that there are always repressed sensual object ties back of tender emotions to which regression may take place. The same is true of hostile feelings. In both connections we must avoid the "Scylla of underestimating the importance of the repressed unconscious, and the Charybdis of judging the normal entirely by the standards of the pathological."

From this he goes on to a brief discussion of the function of sublimation, pointing out that the frustration of complete satisfaction tends to insure the permanency of the bond, since direct sexual bonds are self-destroying in the satisfaction thereof. The sublimated and the uninhibited may be mixed in various proportions and various examples of this and particularly of the tendency to revert or regress from a mixture in which sublimation predominates to one in which the frank and uninhibited sexual bond predominates are given. Marriages that depend chiefly on the purely sexual interest of its components rarely last more than a short time; those marriages which are successful, as has been pointed out by poets and philosophers many, many times, are those in which "affection," i. e., sublimated desires, predominate over the uninhibited or purely physical.

The fourth note added is in regard to the relation of direct sexual tendencies and the formation of groups, which Freud says tend to be incompatible because of the intolerance of the father and because of the demonstration against the herd instinct made by the coming together of two people in love with each other. This rejection of the group is manifested in the sense of shame, and the feelings of jealousy are defense against encroachment by the group tie. But this has developed late in the history of man, because romantic love has developed only late; previously the attachment between male and female was predominantly if not exclusively of the uninhibited or direct sexual type. At first it had as its object the mothers and sisters of the horde or of the primal family, a love which drove to father murder, as a reaction to which, however, there came "the institution of totemistic exogamy," i. e., the incest taboo. "In this way a wedge was driven in between a man's tender and sensual feelings, one still firmly fixed in his erotic life today. As a result of this exogamy the sensual needs of man had to be satisfied with strange and unloved women."

To this Freud adds various illuminating remarks, such as, for example, that the group bond need not be thought of as either homosexual or heterosexual

but rather as undifferentiated; again that the Catholic church had the best motives for recommending and imposing celibacy for reasons above stated. A third remark is to the effect that the disguised regression due to unsuccessful or incomplete inhibition of aim, which shows itself as a neurosis, characteristically removes them from group formations by making them asocial just as the person in love. On the other hand the battle may go the other way and powerful group impetus may displace the neurosis. Hence the increase of neuroses with the decrease of religious dominance and likewise the increase in the mystical religious sects. "If he is left to himself, a neurotic is obliged to replace by his own symptom formation the great group formations from which he is excluded."

The final note is a summary of the four conditions discussed in the book, comparatively stated. Being in love is based on the simultaneous presence of direct and inhibited sexual tendencies; hypnosis is similarly a relation between two individuals, but the bond is exclusively of inhibited sexual tendencies. The group "multiplies this process." The neurosis resembles hypnosis and the group in being a regression and represents a conflict between completely and incompletely inhibited strivings, that is, between sublimations and inadequate repressions. Being in love represents a transference of ego to the object; hypnosis substitutes the object for the ego ideal; the group does this latter and also identifies the object and the ego. The neurosis does all sorts of things; hence its polymorphism.

Such is Freud's contribution to the theory of group psychology. His treatise allows of little discussion less comprehensive than a criticism of his entire psychanalytic thesis. It is characteristicaly mechanistic, and relates to analytic internals rather than synthetic externals. Teleology is not considered. The motives and conditions, the sociologic determinants of the group mind and of mob action are not mentioned. Freud evidently assumes them to be irrelevant, mere academic rationalizations of cause and effect. Herein he leaves a large loophole for his opponents who might quote from Herbert Spencer to the effect that life is explicable neither in terms of psychology alone, nor of sociology alone, but in "the continuous adjustment of internal and external relations."

For it is difficult to conceive of the herd as invariably and solely an *end*, and to negate or neglect its functions as a *means*. The Fascisti, the Quakers, the stormers of the Bastile, the Ku Klux Klan—certainly make no contribution to the theory of leader-worship; their union was ostensibly for certain objectives, better obtained by cooperation, hence by organization. The bobolinks and the buffalo do no less, and do they indeed do more (even with leaders)? Apparently some beasts herd, and some do not; most canines, for example, fall within the first group, most felines within the second, and man, forsooth, in both groups! Must we, in accepting Freud's libido theory as applied to herd instinct manifestations, assume that the libido of the tiger is incapable of the transference to a leader (and to other tigers) of uninhibited sexual instinct, whereas wolf-libido and buffalo-libido allow of these transmutations? Of course Freud could reply that he has psychanalyzed no wolves or tigers.

This is not to scoff, it is merely a query directed at a seeming narrowness or singlemindedness which other students than the reviewer have detected in Freud's philosophic work. Perhaps it is, after all, rather carping. Narrowness may be a requisite of penetration; there are plenty to shovel out the loose dirt. Freud might come to rebuttal with Nietzche's keen insistence that "The origin of the existence of a thing and its final utility, its practical application and incorporation in a system of ends, are *toto coelo* opposed to each other—

everything, anything, which exists and which prevails anywhere, will always be put to new purposes by a force superior to itself." (*The Genealogy of Morals.*)

No one will deny the value and suggestiveness of this contribution. It recasts the libido theory and the most recent conceptions of repression, identification and transference, and indicates how they may perhaps function in mass human relationships. The essay is throughout written thoughtfully, modestly, and moderately and it is rich in thought stimuli. It is a loud, clear tone on a bell now ringing in much news.

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BIOCHEMICAL RESEARCHES ON THE UREA METABOLISM FUNCTION AND ON THE ALTERATIONS OF THE BLOOD IN EPILEPSY. By G. CUNEO. Published as a Memorial by the Royal Academy of Sciences in Turin, 1915.

The experimental part of this work proved by analysis of urine gathered during the period of the convulsion that the urea producing function is normal and that there is no sign of ammoniacal autointoxication. The author was able to disprove the statement that the convulsive manifestations of epilepsy are due to an accumulation of carbamic acid in the organism. In one case of manic-depressive insanity the author found this condition of ammoniacal intoxication caused by the entrance into the circulation of ammonium carbonate which is not transformed into urea. However, this condition never occurs in epilepsy. The ammoniuria which exists in epilepsy is due to an abnormal formation of acids, which are eliminated as innocuous salts, and is not due to a real ammoniacal intoxication. Ammoniuria or acidosis is found in conditions other than epilepsy, but the author believes that a pure ammoniuria is found only in certain manic cases. While working on this question experimentally the author discovered in the blood of epileptics during an attack proteoses which are not regenerated into serum albumin. At this point the author appends a table showing that in sixteen examinations from six epileptics the urine showed a normal relation between the total nitrogen and the ammonia nitrogen and the urea nitrogen. In making this study the author used both twenty-four hour and casual specimens. The urine was collected from patients soon after the attack or in status epilepticus.

The author shows that during the convulsive seizure there is a strong acidosis attributable to a continuous increased formation of organic acids which, when eliminated as ammoniacal salts (because of the deficiency of sodium and potassium salts), produce a noteworthy increase in the ammonia of the urine without interfering with the urea forming functions. If sufficient quantities of sodium carbonate are administered under these circumstances, the ammoniuria disappears and normal relations between total nitrogen and ammonia nitrogen are restored. One patient who had almost daily attacks, yet cooperated perfectly, was selected for the experiments proving this point. The author found that the ammoniuria was not constantly present. If this condition was at all related to the convulsive attack and to an insufficiency of the urea forming functions, it should always be found during the convulsive stage. However, if the ammoniuria was caused by an acidosis it might be possible to have this condition in the urine inconstantly, since these acids, even if continuously present, are by preference eliminated as sodium salts and appear as ammoniacal salts only when these are deficient. The author administered ammonium carbonate and caused an inconstant increase in the elimination of ammonia; then he gave chlorid of lemon (hydrochloric acid with lemon juice) and obtained an enormous increase in the elimination of ammonia nitrogen even up to 80.46 per cent. of the total nitrogen. This increase is entirely due to the ammonia which is used

to neutralize the hydrochloric acid in the formation of ammonium chlorid. This salt of ammonia, unlike the acetates, tartrates, etc., cannot be transformed into urea by the liver. As soon as the hydrochloric acid was discontinued and sodium carbonate administered the ammoniuria disappeared. The patient's condition so far as the convulsions were concerned was not any worse when the ammoniuria was present. The author then administered 4 gm. of ammonium carbonate which was later increased to 6 gm. The proportion between the ammonia nitrogen and the total was immediately increased, while the proportionate relation to urea nitrogen was decreased. The patient's condition was not made worse and the air expired never gave an alkaline reaction. The ammoniuria disappeared.

The most important point in all these experiments was the continuous presence of the abnormal and increased quantity of acid substances in the urine when ammonium carbonate and hydrochloric acid were given.

The author found that the nitrogen balance carefully determined in one epileptic showed a noteworthy increase of the nitrogen in the feces. For this reason one might suspect an alteration in the function of the absorptive power of the intestines. This function always takes place in an alkaline medium. We have just seen that in one epileptic patient there was an increase in acid substances transformed into ammoniacal salts by ammonia, but the feces always remained acid even when sodium and ammonium carbonate were given. This makes one suspect that, not only in the intestinal canal but also outside of it, an acidosis is produced causing acid absorption and elimination. The difficulty of treating epileptics is to be found in the fact that these absorptive functions do not go on exclusively in the intestinal tube itself. These important functions occur in other pathways of absorption which cannot be reached by the gastro-intestinal route directly.

A patient was given 464 calories of albumin, 502 of fats and 1,463 of carbohydrates. This diet was continued for one week. The 113 gm. of proteins in this diet equal 18.14 gm. of nitrogen. The urine and feces were collected for four days. The feces were combined and examined at one time; the urine was examined every day. The urine showed a daily average of 15.49 gm. of nitrogen. The feces mixed with water and glycerin weighed 677 gm. This mixture was triturated and showed 2.61 gm. of nitrogen with the following balance:

		Gm.
Nitrogen introduced with food		18.14
Nitrogen eliminated with urine	15.49	
Nitrogen eliminated with feces	2.61	18.10
Balance		0.04

During this experiment the patient had no convulsive attacks. A month later the experiment was repeated in the hope that the patient would have an attack. This time a total of 2,669 calories containing 20 gm. of nitrogen were given; during four days the urine showed 15.93 gm. of nitrogen and the feces 3.59 gm.; the balance follows:

		Gm.
Nitrogen introduced with food		20
Nitrogen eliminated with urine	15.93	
Nitrogen eliminated with feces	3.59	19.52
Balance		0.48

The patient had three convulsions on each of three successive days during this experiment. These experiments show an increase in the quantity of nitrogen

eliminated, the amount of nitrogen absorbed in the intestines being less than normal, for the feces contain proportionately a great deal more than was found in the feces of a patient in a nonconvulsive stage of the disease. This fact points to some change in the absorptive functions of the intestines. There is no real retention of nitrogen in the blood in epilepsy but a deficient absorption. There is a further possibility that all of the nitrogen absorbed is not eliminated, but is transformed into some nitrogenous substance which enters the circulation. Speculating on the nature of this substance, the author was compelled to turn to the physiology of the absorption of proteins in the intestine for a clue. He quotes Luciani who says: "As a result of digestive processes these substances (proteins) are changed from insoluble to soluble, and from poorly diffusible into easily diffusible substances, and are therefore absorbed by the epithelium which lines the mucosa of the intestinal canal. This transforms them into chyle and by means of a process of internal secretion they are carried on into the lymphatic spaces of the mucosa. This is a vast absorbing area especially in the duodenum and jejunum which is provided with extensive valves and numerous long villi. The proteoses and peptones are marvelously utilized. By synthesis they are changed into serum albumins through the influence of the anabolic activity of the epithelium. Neither the proteoses nor the peptones are ever normally found in blood or lymph, i. e., one never obtains the biuret reaction. In some way, before these substances enter the blood and lymph they must be modified in order that their toxic action may be neutralized because the substances injected in the blood are extremely toxic."

Cuneo goes on to say that it must be at this precise point that the proteoses and peptones instead of being synthesized into serum albumins or globulins in the plasma of the blood may at least in part enter the circulation and cause the well-known phenomena of albumosemia: toxic spasms with cries, violent contractions of the stomach and intestines (vomiting and evacuation), weakness of the heart muscle, lowered blood pressure, increase of the secretions, narcosis, incoagulability of the blood and a leukopenia. Many of these symptoms have been described in epileptics, especially in status. They have been produced by the injection of gastric peptones 3 gm. for every kilogram of body weight of the animal. In such animals both peptones and proteoses are obtained from the plasma.

Others have described leukopenia in epileptics. Pighini demonstrated that the nucleolitic action of the serum taken from epileptics shows a change during the attack. The nucleolitic activity of serum consists in hydrolizing the nucleinic acid and this enzymic action can be observed with the polarimeter. Pighini explains this activity as being caused by the nuclease of the serum. It is practically absent when the epileptic patient is confused or in the attack, very much weakened after two attacks occurring only a short time before, and becomes normal only three or four days after the attack. In this connection Cuneo says that the deficient nucleolitic activity occurring in epileptics is an expression of disturbance in the metabolism and interchange of nucleinic substances. He explains it by the presence of proteoses in the blood of epileptics during the attack. Hofmeister has shown that the proteoses are tied up with the protoplasm of the leukocytes, in this way disappearing from the serum where they are found when injected experimentally. It is owing to this affinity of proteoses for leukocytes that they are absorbed without exhibiting toxic action and without being eliminated in the urine. To accomplish this a new combination, having different properties, must be formed, and on the other hand the number of leukocytes will therefore be diminished. Leukocytes contain nucleinic acid essentially and this fact explains the Pighini phenomenon which is an

activity of the nuclease on the nucleinic acid. This activity is least during or shortly after an attack, precisely when the leukocytes tie up with the proteoses. As new leukocytes are substituted for those that disappear in the new combination with the proteoses, the nucleolitic action returns to normal. The brevity of the epileptic reaction is explained by the fairly rapid combination of the proteoses with the protoplasm of the leukocytes thus losing their toxic action. The liver which neutralizes most poisons is known to allow the passage of proteoses unaltered. This concept of proteosemia in epilepsy is further suggested by the fact that during digestion a leukocytosis occurs, which gradually disappears as the proteoses formed in the ordinary processes of digestion are tied up to the protoplasm of the leukocytes.

The author says that the urine in epileptics shows increased urea nitrogen when the determinations are made with copper salts instead of phosphotungstic acid. This never occurs with normal urine. The difference is explained by the presence in the urine of some product of the transformation of the proteoses, thus reacting with copper salts as the proteoses themselves do, the proteoses being precipitated by phosphotungstic acid and not by the copper salts. Thus in the first case the proteoses are calculated as non-urea nitrogen, in the second case as urea nitrogen.

The blood of epileptics obtained immediately after the attack contains an albuminoid substance that gives all of the special reactions of the proteoses. This substance is not found in the blood of cattle, in cases of dementia praecox, nor in the blood of those epileptics who have not had recent convulsive seizures. These experiments were made on the blood of three cases of dementia praecox, three bulls and ten patients suffering from epilepsy. Two of these patients had several examinations. Three patients who had not had a convulsive attack for a long time gave negative reactions for the presence of proteoses. The blood after dialysis was always neutral and a table is appended giving the weight of the water content, the dry residue, the quantity of nitrogen and of albuminoids. The tests were made with picric acid, phosphotungstic acid, the reagent of Tanret, with acetic ferrocyanid of potassium, with saturated sulphate of ammonium, sodium acetic chlorid (saturated) and finally with the reagent of Biuret. With this last reagent the cases of epilepsy having recently had convulsions all gave a marked violent red color. With the potassium acetic ferrocyanid all of the reactions were negative except for a light precipitate or slight opalescence in two patients who had not had a convulsive attack. This demonstrates that after the albuminoid substances were coagulated by heat nothing remained in the filtrate which could be identified as a coagulable albuminoid because this reagent precipitates such substances. This fact makes all other results more certain. The author states that the blood of epileptics immediately after the convulsive attack shows a diminution of the water content and a proportionate increase in the amount of nitrogenous substances. The analyses of Abderhalden on normal blood show an average of: water gm. 824.55, and dry residue 175.45 gm. One thousand grams of blood contains 26.7 gm. of nitrogen corresponding to 166.83 gm. of albuminoid substance. This figure is obtained by the method of Kjeldahl, multiplying the nitrogen found by 6.25. The author feels that his results are conclusive. In all of his cases of epilepsy showing recent convulsions the amount of dry residue was more than 200 gm.

To further check up on his work the author tried the methods of Claude Bernard, using a saturated solution of boiling sodium sulphate; he also used trichloracetic acid and iron acetate, but finally had to give these up because they disturbed the reaction of the proteoses. Finally he did not use any reagent,

but acted on the principle that the proteoses and the peptones do not coagulate with heat. In normal blood, which is alkaline, albuminoid substances are not entirely precipitated, those remaining in solution being the alkali albumins which interfere with the researches for the proteoses and peptones. This difficulty was surmounted by dialysis which after twenty hours liberates all of the alkaline salts of the blood while all those colloid substances having a neutral reaction remain. This filtrate is neutral but does not filter well if it contains albumin. It has a pale gray color and when calcined leaves a black residue which swells like an albuminoid substance. In identifying this substance, the author again eliminated the possibility that albumin had passed into the filtrate by using potassium acetic ferrocyanid. Also, the same technic used on the blood of cattle and the blood from patients suffering from dementia praecox failed to show the presence of this substance. It was found only in epileptics who had recently had a convulsive attack.

The author also made experiments to eliminate the possibility that autolysis might account for his results. In one series of experiments calculated to eliminate this source of error he used the blood of cattle which had remained in sterile tubes for two months. He also subjected the blood taken from epileptics who had very recently had a convulsive attack, to boiling at 100 C. for fifteen minutes. This would certainly destroy the activity of autolytic processes or proteolytic activities which might cause the albuminoids to be transformed into products of digestion. Instead, the same substance as described in the above experiments was obtained. All of these experiments are described in detail. The author also found, as a result of this work, that the substance which he identifies as a proteose is not only incoagulable, but also rather easily diffusible. To demonstrate this one must remember that the affinity of the proteoses for the leukocyte prevents these substances from passing through the dialyzer. Also it must be remembered that these substances, even when free, pass through the membrane more slowly than do mineral salts. The simple process of boiling for fifteen minutes allows the albumins to coagulate and also liberates the proteoses from the leukocytes. If this dialyzed filtrate is repeatedly boiled for ten minutes eventually the reactions identifying the proteoses in the precipitate become less marked and finally disappear. The author states that these reactions were never found in the urine.

The proteoses are not indifferent substances. They act at times as true acids. On the other hand the hetero-albuminoses contain 39 per cent. of their total nitrogen in basic form, whereas the proteo-albuminoses contain less nitrogen bases. When they are precipitated with phosphotungstic acid they are found combined with this acid. In this respect they are like the albuminoids and are thus in harmony with the amino acids which are their principal constituent. When albuminoid substances are dialyzed, they become transformed into albuminic acid which, combining with the proteoses, prevents them from being identified as free substances. With this in mind the author attempted to liberate the proteoses from every tie as follows: As the blood escaped from the vein it was immediately mixed with six or seven times its volume of distilled water in order to destroy the cells (globules), thus obtaining a solution free from coagulable substances. This mixture was kept for one hour in a solution of iced salt. This was then dialyzed for twenty-four to thirty hours to remove the mineral substances. This solution is neutral. It was placed in a boiling bath for fifteen minutes, cooled and thus could be preserved for many days. The filtrate from this liquid obtained from epileptic patients who had recently had an attack, was always colored brownish yellow or coffee color. It

filters very slowly, but more rapidly than albuminoid liquids. At times it is clear and quickly gives the proteose reactions; at other times it is cloudy and these reactions are less marked. This depends entirely on whether they are in a free state or not. When the latter occurs this combination may be destroyed by adding a few cubic centimeters of potassium hydrate or sulphuric acid, according to whether the proteoses are tied up as bases or acids. In adding these substances to the solution the author was always careful to make the solution neither alkaline nor acid. This was done to prevent the possibility of error.

The author then devotes the next seven pages to a detailed description of the technic of his biochemical researches in the case of each of the epileptic patients whose blood was examined. It is important to note that in one of these, the epilepsy was purely symptomatic, the patient suffering from a birth palsy. This patient's blood gave negative reactions for the proteoses. This substance was never found in epileptics who were enjoying periods of freedom from attacks.

In this article written in 1915 the author admits that he has not completely explained the pathogenesis of epilepsy. He has opened the way for further study and has continued his researches. A short abstract by the reviewer of these newer invesigations appeared in the *Archives of Neurology and Psychiatry*, **9**:488 (April) 1923. Cuneo has promised to publish his therapeutic methods in a complete article which will appear soon.

OSNATO, New York.

THE PATHOLOGY OF THE VEGETATIVE FUNCTIONS OF THE SKIN. HELMOT BÖWING, Deutsch. Ztschr. f. Nervenheilk. **76**:71 (Feb.) 1923.

The constant variation in the blood-vessels of the skin is maintained by the vasodilators and constrictors, influenced by peripheral and central stimuli. This is controlled by the vegetative nervous system and accordingly should manifest some variations from the normal in diseases of the nervous system. The author reports his observation of various nervous diseases, peripheral and central. The method of examination was the macroscopic observation of blood-vessel changes in the skin produced by stroking with a percussion hammer handle and a needle. This reaction is spoken of as a dermographia.

Dermographia in the Healthy Individual.—A gentle stroking with the percussion hammer handle produces after from ten to twenty seconds, a white, anemic line, definitely defined and about 5 mm. wide, most pronounced over the abdomen and thigh. This disappears in from three to fifteen minutes. It is spoken of as dermographia alba. More marked irritation produces after from five to fifteen seconds a red hyperemic line about 5 mm. wide, and limited on both sides by a narrow anemic margin. This is designated as dermographia rubra. Dermographia alba is due to vasoconstriction and dermographia rubra to vasodilatation, the gentle irritation affecting the constrictors, while greater stimuli influence the dilators. A third form of skin writing is dermographia reflexiva, the irritative reflex erythema of L. R. Müller. This is produced by painful stimulation, such as scratching the skin with a needle. Within from twenty to sixty seconds hyperemic (rarely anemic) irregular islands occur on all sides within 5 cm. of the irritated area, and remain about fifteen minutes. At a distance, this area appears as an irregular red line of varying intensity.

All forms of dermographia are less pronounced on the forearm, hands, legs and feet. Dermographia rubra occurs most readily over the anterior chest wall. Dermographia alba cannot be produced in some individuals at all, and in others only on the lower abdomen.

According to L. R. Müller, dermographia rubra and alba occur regardless of spinal and cerebral vasomotor control, but dermographia reflexiva is produced by a definite spinal reflex.

Sixteen cases of hemiplegia were examined, six due to cerebral hemorrhage and six to cerebral embolus in the region of the internal capsule; four were caused by brain tumors. In three cases there was also anesthesia of the paralyzed side. In fifteen cases no difference could be noted in the dermographia alba, rubra or reflexiva, between the paralyzed and the normal side. Three cases were examined within a few hours after the onset of the hemiplegia and repeated observations made with similar findings. The sixteenth case was a left hemiplegia of six months' duration, secondary to cerebral embolus from endocarditis. On one occasion, dermographia alba was more pronounced on the hemiplegic side and dermographia rubra on the healthy side. This was probably due to the fact, that the temperature of the affected side was lower. This brief observation does not signify an absence of circulatory disturbances in cerebral lesions, for the hemiplegic extremities were frequently cooler and paler than normal; rarely warmer and congested. There was a tendency to edema. The most frequent finding was a difference in the blood pressure, which was higher on the hemiplegic than on the normal side.

Thirteen cases of paraplegia were observed. The character of the paralysis, flaccid or spastic, and the sensory level had no effect on the dermographia alba or rubra. As a rule, the dermographia alba was more pronounced in the paralyzed extremities, while the dermographia rubra was decreased. In several cases the dermographia reflexiva was lessened, while on one occasion it was quite pronounced. The region supplied by the segment at the level of the lesion was carefully studied. In only one case (first lumbar segment lesion) was an absence of the dermographia reflexiva noted. In a case of lower sacral lesion with the characteristic anesthesia, dermographia reflexiva was noted around the anal region, while it was entirely absent in this same area in two cases of caudal compression. The increase in the dermographia alba was probably due to a lower temperature and impaired circulation of the paralyzed extremities. It cannot be explained as due to an absence of cerebral inhibition on the vasoconstrictors, as there is no increase of the dermographia alba after peripheral nerve section. A similar explanation is given for the decrease in the dermographia rubra and reflexiva. In the one case in which the dermographia reflexiva was absent at the level of the lesion, evidently the reflex center in the spinal cord was destroyed. Similarly in the two cases of caudal compression, the reflex arc was interrupted.

Two cases of peripheral nerve injury were studied (left sciatic and left brachial plexus). In both instances, the dermographia alba and rubra were normal, while the dermographia reflexiva was absent. This further demonstrates Müller's contention that dermographia alba and rubra occur in the skin itself, while dermographia reflexiva depends on the reflex arc. From a brief review of the literature and the above observations, the author concludes that after peripheral nerve section, there is an absence of spinal reflex hyperemia. But dilatation of the smaller blood-vessels and capillaries can still be produced through irritation of the vasodilators or paralysis of the vasoconstrictors. Similarly a contraction of the blood-vessels can occur through irritation of the vasoconstrictors. The centrifugal nerve paths for the dermographia reflexiva are the vasodilator fibers, as the vasoconstrictors are not involved in this phenomenon. The centripetal path passes through the sensory tracts, which, according to Baylitz, are identical with the vasomotors. In all probability, the pain and temperature tracts are the important tracts as the dermographia

reflexiva is produced only by temperature and pain irritation and not by pressure stimuli. However, two cases of syringomyelia are reported, in whom dermographia reflexiva occurred in the skin in which pain and temperature sense were absent. The explanation given for this was that the vasodilator reflex arc was completed on the same side of the spinal cord before the pain and temperature paths were interrupted. Therefore, collateral branches to the vasodilator centers in the lateral horn of the spinal cord are given off from the pain and temperature fibers soon after their entry into the cord.

Studies of the blood pressure in the paralyzed extremities of paraplegias were made. The Riva Rocci instrument was found unreliable because of the position of the blood-vessels in the lower extremities. A tonometer (Fa Erbe, Tübingen) proved satisfactory. In the recumbent posture, the blood pressure was found practically the same in the upper and lower extremities in healthy individuals. Four cases with spastic paraplegia had a normal blood pressure in the arms, while it was from 10 to 30 mm. of mercury higher in the lower extremities. A similar condition was observed in a recent flaccid paraplegia due to a fracture of the first and second lumbar vertebrae. This increase in blood pressure is probably due to a loss of cerebral inhibition on the vasoconstrictors. A lowered blood pressure, such as occurs in animal experimentations on spinal cord section, has not been observed in the man. Application of ice (to test the vasoconstrictor cold reflex) to the paralyzed extremities had no effect on the blood pressure either in the arms or legs. However, a similar application above the level of the lesion increased the blood pressure in the arms from 10 to 20 mm. of mercury without any change in the lower extremities. Accordingly, the vasoconstrictor reflex arc is completed in the medulla or brain. The blood pressure in an arm, paralyzed from a lower brachial plexus lesion, was 10 mm. of mercury higher than in the sound arm. This demonstrates that in the upper extremities increased blood pressure also occurs when the spinal cord connections are interrupted.

The author briefly reviews the literature in regard to the vasomotor centers in the midbrain and concludes from animal experiments and clinical cases that the midbrain exerts a definite controlling influence over the vasoconstrictors. Also vasodilator impulses originate in the brain, as is demonstrated in blushing and anger. Furthermore, he reports two cases of hemiplegia, in which definite vasodilator phenomena were observed. However, the vasoconstrictor manifestations are more frequent and more pronounced.

The blood pressure in recent and old hemiplegias was further studied in relation to the paralyzed side. In five recent cases an increase of from 5 to 20 mm. of mercury was noted in the paralyzed arm, which was supposedly due to loss of cerebral inhibition on the vasoconstrictors. Four old hemiplegias with contractures gave a lower blood pressure, from 7 to 35 mm. of mercury on the paralyzed side. This was probably due to a lowered tone of the peripheral blood-vessels.

A further study of the disturbances of the sweat glands in organic nervous diseases is reported. Twelve cases of transverse lesion of the spinal cord were observed. The theory that there is usually no disturbance in the function of the sweat glands in cases of spastic paraplegia and diminished secretion in flaccid paraplegia could not be confirmed. In four cases of spastic paraplegia, one manifested no disturbance, while in the remaining three anhidrosis was noted in the paralyzed extremities. In six cases of flaccid paraplegia, three manifested normal function and three an anhidrosis. An increased function was not noted in any case. In the cases of paraplegia without any disturbance,

evidently the sweat centers and fiber tracts remained intact. Lessened function of the sweat glands occurs when there is lack of control of the primary centers in the corpus subthalamicus, while the spinal sweat centers are intact. For that reason, hypohidrosis frequently occurs in paraplegias. Complete anhidrosis occurs only when there is organic or functional paralysis of the spinal sweat centers below the level of the spinal cord lesion. It is rarely observed.

Seventeen cases of hemiplegia were studied and in fourteen hyperhidrosis was noted on the paralyzed side. These were divided into three groups according to the location of the lesion: hemihyperhidrosis in cortical and capsular lesions; hemihyperhidrosis in lesions of the striate system; hemihyperhidrosis in lesions of the corpus subthalamicum. The extent and intensity of the hyperhidrosis was a diagnostic aid in the localization of the cerebral lesion. As a rule in the first group, hyperhidrosis was noted in the hand, axilla, under the breast and on the abdomen of the paralyzed side; in the second group, hyperhidrosis was also observed in the face; in the third group it occurred over the entire paralyzed side and was much more pronounced than in the other two groups.

Pilocarpin, because of its peripheral effect and variable reaction, was found unreliable in this study. The electric bath gave more satisfactory and accurate results. The slighter variations in the disturbances of the sweat glands could only be recognized by spontaneous sweating.

In a study of the arrectores pilorum reaction in organic nervous diseases, the author arrived at the following conclusions: It is necessary to differentiate between the generalized pilomotor spinal reflex and the local arrectores pilorum reaction. The generalized spinal reflex develops hemilaterally (occasionally bilaterally) after skin iritation and is transmitted from the spinal cord by way of the funiculus marginalis. Elimination of the brain centers intensifies this. Under certain conditions this generalized reflex can be initiated in the brain. This occurs in psychic states favorable to the arrectores pilorum reaction. According to Pawlow, a definite reflex occurs in these cases. In pathologic conditions, a localized spinal reflex can develop in those areas not accessible by the general reflex. The local arrectores pilorum reaction occurs only in the skin area directly irritated by mechanical, thermic or electric stimuli, and is intensified when the paths to the nervous system are interrupted.

The pilomotor reflex extends into areas having no direct nervous relation to the point of initiation. This may be due to the erection of the hairs on the skin acting as new stimuli. The areas of sensation of the deep seated spinal centers are reached through the extensive pilomotor dermatomes and their bilateral overlapping. In this way, the reflex can extend over the entire nervous system and even into paralyzed extremities. This explains the wave-like pilomotor reaction which can be observed on the individual. However, it is possible that the generalized pilomotor reflex develops through impulses passing by way of the funiculus marginalis. This could also explain the extension of this generalized reflex into the paralyzed extremities below the level of the lesion. In eleven cases of paraplegia, the generalized spinal reflex developed over the entire body in nine patients. In one case, insufficient pilomotor response was given as a cause for the absence of the reflex. In the other case complete inhibition of the pilomotor reflex in the inguinal region prevented its extension into the lower extremities.

André Thomas' observations regarding localization of pilomotor centers in the spinal cord were verified. Furthermore, from evidence obtained in two cases of sacral lesions it would seem that pilomotor centers are also located in the lumbar cord. In fifteen cases of hemiplegia, eight gave increased arrectores

pilorum reaction on the paralyzed side. In only one case was this noted on the healthy side. In another patient, the increased reaction alternated between the hemiplegic and normal side; three cases manifested no difference and in two patients, no generalized pilomotor reflex could be obtained. The increased reaction on the hemiplegic side is probably due to an absence of cerebral inhibition and partly to a lowered temperature on the affected side.

An increase of temperature on the paralyzed side may be accountable for the lessened reaction on the affected side, as rarely observed. Hemianesthesia of the hemiplegic side does not prevent the increased arrectores pilorum reaction.

HAMMES, St. Paul.

THE CENTRAL HYPOGLOSSUS TRACT. EXPERIMENTAL AND ANATOMIC INVESTIGATIONS. G. MINGAZZINI, J. f. Psychol. u. Neurol. **29**:273 (March) 1923.

The object of this investigation was to determine first, the origin, course and terminations of the central and peripheral hypoglossal tracts by studying the functional disturbances of the tongue following their extirpation, and, secondly, the anastomoses between the hypoglossal tracts and neighboring nerves (seventh, tenth, fifth and eleventh). The experimental work was carried out exclusively on the *Macacus* and *Cynocephalus* species of monkeys. After describing the experiments in detail, Mingazzini points out that on phylogenetic grounds the hypoglossal nerve cannot be regarded as an independent cranial nerve. As a matter of fact he does not include it among the cranial nerves at all, but is inclined to place it in a group of genuine mixed spinal nerves in which the motor components are far in excess of the sensory. To substantiate this view he traces the phylogeny, morphology and distribution of this nerve through the various species in the zoologic scale of vertebrates. The morphology of the twelfth nucleus in man does not differ from that in the monkey, although the sensory collaterals are much better developed in man. All observers agree that the twelfth nucleus consists of a more extensive spinal (distal) and a shorter cerebral (proximal) portion. In the former, one can distinguish two groups of nerve cells—a ventral and a dorsal group (dorsomedial and dorsolateral); in the cerebral portion one can distinguish a dorsolateral, a dorsoventral and an exclusively mesial part—the lateral group of cells of the twelfth nucleus in man tends to join distally the dorsal group and proximally the ventral group. Mingazzini's experiments show that the various nerve cells in the distal segments of the twelfth nucleus are connected with the homolateral root fibers, and that the ventral cells are the first to show the effects of section of the twelfth root. He also finds that the glossocorticobulbar tracts join some of the nerve cells of the distal portion of the nucleus of the twelfth nerve from the contralateral side. This is probably due to the fact that the ventral or ventrolateral group of nerve cells from the distal segment of the twelfth nucleus is also connected with the contralateral glossomotor center. In some of the animals, however, it was found that this same group of cells was connected with the contralateral as well as the homolateral corticobulbar tracts. Some of the nerve cells of the mesial portion of the twelfth nucleus are connected with the root fibers of the homolateral twelfth nerve; they are especially and very closely connected with the nerve cells of the lateral, and also with the dorsal and median group, but less so with the central and ventral, because the latter remain frequently unaffected after recent section of the twelfth root. Extirpation of one or both twelfth nerves along the proximal portion of the homolateral twelfth nucleus was followed by a disappearance of the dorsolateral, and occasionally

of the ventral group of nerve cells of the same nucleus; it must also be mentioned, however, that the cells of the other groups also showed definite evidences of involvement. The results were approximately the same, when, in addition to the hypoglossal, the homolateral facial or homolateral vagus was cut. Experimental as well as clinical evidence is presented to show that these various groups of cells of the twelfth nucleus do not develop at the same time. Ontogenetically the dorsolateral group is much younger and therefore less resistant than the other groups. It seems also that the fibrae coronariae contralaterales are closely connected with the sensory collateral fibers and with fibers of the corticobulbar tract. The clinical application of this becomes evident in cases of hemiatrophy of the tongue (peripheral in origin) in man, in which a circumscribed number of nerve cells do not become atrophied for a considerable period of time; this is due to the fact that the innervating effects of these sensory collaterals and of the uninvolved hypoglossopyramidal fibers are still able to exert their stimulating influences.

As far as Duval's and Roller's nuclei are concerned, Mingazzini states that in his experiments with monkeys he could find nothing that could in any way be said to correspond to these nuclei.

The small size of the nerve cells of the nucleus intercalatus (appositus), which arises from a small collection of nerve cells and nerve fibers (staderini) on the dorsolateral margin of the twelfth nucleus, did not permit the author to draw definite conclusions as to the effect of hypoglossus section on these cells.

Frontal section of the most proximal portion of the cervical segments showed no changes in the anterior horn cells after section of the twelfth nerve in front of the ansa.

The changes in the fibrae propriae and in the nerve cells of the twelfth nucleus were considerably less marked after extirpation of the contralateral glossomotor centers than after section of the twelfth nerves. It was also noteworthy that after the central or peripheral extirpations already mentioned the degeneration did not affect all parts of the tongue to the same extent. That the same is also true in the case of man has been confirmed by many previous observers. It is a well-known clinical fact that in tabetic hemiatrophy of the tongue the atrophy is most marked in the most lateral portion of the tongue. Hematoxylin stained sections of atrophied tongues in monkeys showed a complete disappearance of the sarcoplasm in some muscle fibers, leaving only the perimysium intact; other fibers again appeared markedly swollen so that no traces of sarcoplastic striation could be seen.

Section of the seventh (one or both sides, together with the twelfth nerve) was always followed by atrophy of the dorsal and mesial groups of nerve cells belonging to the seventh nucleus; those of the lateral group and of the ventral pole remained partly unaffected but after a considerable period had elapsed they also became atrophied. It would seem, then, that in monkeys, at least, the central cells of the seventh nucleus are almost always most resistant. This series of experiments also proved that extirpation of the seventh nucleus did not intensify the lesion of the twelfth nucleus, nor did it make it more evident. This is of some clinical importance, because not a few clinicians (Gowers) have maintained that in man the musculature supplied by the seventh nerve (orbicularis oris) was also partly supplied by the twelfth nerve.

Histologic examination of the fibrae propriae of the twelfth nucleus shows the presence of the plexus endonuclearis (situated in the most ventral portion of the nucleus) and the plexus perinuclearis, or plexus periphericus (Obersteiner's myelin field) situated on the margin of the nucleus itself. The dorsal

component of the nucleus (cappa nuclei of the twelfth nerve) forms the dorsal longitudinal fasciculus (longitudinal bundle of von Schultze), and its mesial component (sickle-shaped) is the so-called lunula. The plexus endonuclearis in cats and monkeys is formed by three elements: (1) the terminals of the root fibers of the twelfth pair of cranial nerves; (2) the terminal branches of the central (hypoglossopyramidal) tract; (3) the anastomosis of the nerve cells of the twelfth nucleus, which are probably connected with the tenth nerve and the sensory tracts. These findings are in harmony with the chronology of myelinization of the plexus endonuclearis. The plexus perinuclearis is formed practically by the same elements and also by the fasciculus intercalatus.

As to the innervation of the soft palate and vocal cords, Mingazzini states that the most acceptable theory is that certain axis cylinders arise from a group of nerve cells of the twelfth nucleus, and, after contributing to the formation of the hypoglossus root, anastomose extracranially with the twelfth and tenth nerves, forming alongside the tenth the recurrent nerve, which innervates the abductors of the vocal cords. Another group of axis cylinders arising from the twelfth nucleus run their course as the so-called fibrae suprareticulares, which through the roots of the vagus innervate the soft palate.

As to the movements of the tongue, the hypothesis is ventured that the lateral groups of nerve cells and the lateral root fibers of the twelfth nerve influence the coarser movements of the tongue, whereas the mesial root fibers, those subserving the cerebral cortex, influence indirectly the finer movements of that organ. A logical sequence of this hypothesis would be that in cases in which one glossomotor center and its contralateral hypoglossal nerve were extirpated, a greater number of nerve cells of the twelfth root fibers would become atrophied than in cases in which only one twelfth nerve or only one glossomotor center was removed. This was actually found to be the case in monkeys experimented on with this view in mind.

The results of investigations in man as well as in experimental animals seem to speak against the assumption that the so-called afferentes of the twelfth nerve bear any relation to the nucleus of that nerve, or that they belong to the pyramido-hypoglossus tract.

Ablation of a large part of the lower fourth (occasionally of the lower third) portion of the precentral gyrus in monkeys was followed by a moderately intense degeneration of the corticobulbar tract extending from the internal capsule to the nucleus of the contralateral twelfth nerve.

In man, unilateral atrophic paralysis of the tongue due to peripheral (nuclear or truncal) involvement shows the following manifestations: When the tongue is at rest in the buccal cavity, it is usually elevated posteriorly, and deviates almost always to the healthy side; when, however, the patient (with the mouth open), attempts to protrude it, its tip usually, though not always, deviates to the diseased side and its raphé assumes concavity to the same side. The symptomatology, however, is entirely different in cases of bilateral paralysis of the tongue following peripheral injury to the twelfth nerve. In that case the paralyzed tongue adapts itself passively to the shape of the angle of the lower jaw with its base falling backward, and the patient is unable to protrude, elevate, or pull it back; it may be seen for several minutes to remain perfectly quiet and without the slightest tremor. Attempts at swallowing are carried out by throwing the food into the esophagus after a sudden bending of the head backward. It becomes at once evident that the tongue does not participate to the slightest extent in the act of swallowing. After section of the twelfth nerve or nerves, extirpation of the seventh has no effect on the symptomatology of unilateral or bilateral paralysis of the tongue.

The experiments showed further that ablation of the glossomotor center on one side may also be followed by atrophy of the contralateral half of the tongue. After extirpation of the twelfth nerve, the atrophy was more marked and appeared much more rapidly than after extirpation of the glossomotor cortical center. In monkeys the atrophy of the tongue following combined extirpation of the homolateral hypoglossal nerve and of the contralateral glossomotor center was more marked than after the removal of the contralateral cortical center alone. Atrophy of the tongue, whether central or peripheral in origin, always begins first at the tip; it then involves the anterior third and finally the entire organ. It might be inferred that the atrophy of the tip and to some extent also of the anterior third of the tongue depended mainly on the immediate relationship of the latter to the innervation of the geniohyoglossus muscle, whereas the atrophy of the remaining part of the tongue depended on the innervation of the styloglossus muscle which is supplied by the facial nerve, at least, partly so in the sense of a vicarious replacement of innervation following the lack of innervation by the twelfth nerve after the latter had been sectioned or diseased. Mingazzini's experiments, however, do not confirm such a hypothesis.

As to the trophic phenomena of the tongue. There is no doubt that the twelfth nerve has a certain number of vasomotor fibers which enter the occipital sinus, and which probably originate from the superior cervical ganglion anastomosing directly with the twelfth nerve (Bechterew). It is also probable that the lingual branch of the trigeminus contains vasodilator fibers originating wholly or partly from the cervical sympathetic which supply the anterior part of the tongue and through the chorda tympani, the lingual glands. The presence of these fibers within the branches of the lingual nerves explains the apparent motility (pseudomotility) of the tongue following section of the hypoglossal nerve. This question, however, still remains unsettled.

Electrical reactions: After extirpation of one or both hypoglossal nerves, the electrical excitability of the homolateral musculature of the tongue is increased, but this hyperexcitability diminishes qualitatively the more marked the muscular atrophy becomes. The results are the same in man as in the monkey. The simultaneous ablation of the facial and vagus does not alter the electrical changes described. Extirpation of the glossomotor center gives rise to a diminution of the faradic and galvanic excitability, or only to a change in the faradic irritability in the contralateral musculature of the tongue. Inversion of the formula is extremely rare.

The author's experiments show that each laryngeal cortical center has a partly bilateral innervation. Some observers attribute the motor innervation of the palate to the hypoglossus, others to the facial, and still others to the motor branch of the trigeminus. Mingazzini's experiments show definitely that the vagus fibers are chiefly concerned in the motor innervation of the palate, and that the hypoglossal as well as the facial participate only slightly, and in some instances the facial may not send branches to the palate at all. It is also pointed out that the syndrome of labioglossopharyngeal paralysis, in which the chief symptoms are hemiatrophy of the tongue, atrophy of the soft palate and paresis of one vocal cord, is not necessarily evidence of a central lesion, because in the so-called Jackson's syndrome (hemiplegia glossopharyngolaryngea) the lesion is, par excellence, peripheral. The same is also true of Tapia's syndrome, hemiplegia glossopharyngea (without paralysis of the soft palate), which is usually due to extracranial disease or postoperative trauma.

The paper is concluded with a study of dysphagia, in which it is found that dysphagic disturbances are not constant after extirpation of the twelfth nerve. Removal of the glossomotor center on one side was not followed by disturbances in swallowing. This, however, was not invariably the case.

The paper is unusually well illustrated.

KESCHNER, New York City.

Society Transactions

BOSTON SOCIETY OF PSYCHIATRY AND NEUROLOGY

Regular Meeting Nov. 15, 1923

F. K. Hallock, M.D., *President, in the Chair*

A CASE OF NARCOLEPSY. Dr. Karl M. Bowman.

A year ago, at a meeting of this Society, I presented a case of narcolepsy of nine years' duration in a girl aged 22. The attacks had started at the age of 13, following an attack of chorea. The results of physical examination were essentially negative. There was an abscess of the right lower central incisor, and right internal strabismus. Other neurologic and serologic findings were negative. The spinal fluid sugar was 65 mg. per 100 c.c. The roentgen-ray examination showed the sella to be of normal size with possibly slight erosion of the anterior face of the dorsum. The anterior clinoids were very long and almost met the posterior clinoids. The basal metabolism was minus 18 per cent. and there was a definite tendency toward a flat or reverse type of blood sugar curve. On the basis of these findings the possibility of an endocrine disorder particularly of the pituitary, as the basis of the narcoleptic attacks was considered and since June, 1922, the patient has been under organotherapy. Principally, various pituitary and thyroid preparations have been tried. Pituitary extract was given intranasally and subcutaneously with no particular effect. Posterior pituitary substance likewise produced no effect. Thyroxin given intravenously raised the basal metabolism but failed to alter the blood sugar curve, and produced very slight if any improvement. Anterior pituitary substance seemed to produce definite though slight improvement. Whole pituitary gland produced definite and marked improvement. Various preparations of thyroid, whole pituitary and ovarian substances have been tried and at the present time the patient is taking a mixture of thyroid, ⅓ grain (0.02 gm.) with whole pituitary gland 2 grains (0.12 gm.) three times a day. There is marked improvement in her condition, and in order to test the effect of medication it has been discontinued for brief intervals; at such times the narcolepsy invariably increases. Furthermore the patient has, at times, neglected to take the medicine for a day or two and it has been noted that her symptoms became more pronounced. The condition has not been cured by endocrine therapy but there has been a definitely beneficial effect.

A PSYCHOSIS DIFFICULT OF DIAGNOSIS. Dr. William Herman.

A woman, aged 48, married for twenty-eight years, a devout Baptist, was brought to the hospital because she had heard the voice of God and the Holy Spirit telling her to cross a marsh to save an outgoing ship. She had also heard God's voice telling her to pluck a perfect bunch of grapes from vines already picked clean. She later stated that when she found a few imperfect grapes she was led to think of people who were imperfect in their religious faith. At this time she seemed to have unusual physical agility; whereas, a few days before, she had felt a good deal of slowing in her thinking and general working activity.

Organically nothing positive had been found; basal metabolism was normal. Partial hysterectomy had been performed fourteen years before and there had been no flow since. She had three sisters who suffered with depression and ideas of reference at the time of the menopause, between the ages of 40 and 50. She was one of a family of seven. Her early life and social background is of greater importance. She was born in a small town in Vermont. Her father died when she was young, and the mother went out to work, the children being placed in different families. The patient did housework and waited on table. At 14 she had a premarital sex experience; she felt she could not marry a man with whom she had sinned. She came to Boston when 19, and married a Tufts graduate secretly. The fact of the marriage came out after six months. She was under a constant strain lest her behavior should not be suitable for the group into which her husband took her. To the one child, a girl, she wished to give all the things she herself lacked. She was very ambitious for her and sent her to Holyoke; but the girl was quickly withdrawn because the atmosphere seemed somewhat worldly. She was then sent to Boston University. About a year ago, the girl took a course in evolution, and once on coming home told the mother the Bible was a myth. The husband was not religious, and the patient's greatest conflict was that she would be called at Christ's second coming and her husband and daughter would be left. Up to a year ago she was under the constant guidance of a pastor, who knew all about her life. He represented "God on earth" to her and "was more than a father to her." He died a year ago and she now has no pastor she cares for. This culmination of strains, her feeling of social inferiority, worry over her daughter's salvation, and the loss of her spiritual guide, coming at the time of the additional strain of involution was just a little more than she could bear.

It is very hard clearly to place this case. She also had an unusual ability to achieve physical things, such as climbing the ladder and crossing the marsh without fatigue. Prior to the episode of the grapes, she suggested a good deal of thinking difficulty. There is surely an admixture of affect. The voice tells her to reach this perfect bunch of grapes and she makes arrangements to perform this unusual thing. There seems to me here a certain amount of primitive symbolic thinking, and her own comparison of grapes to people of imperfect faith is easily given. Her treatment has been rather vicarious. She accepts very little in the way of suggestion, but it seemed to me that we could replace some of the props she has lost. The daughter has been asked not to talk about evolution and not to criticize her mother's English, which she has been in the habit of doing. The local clergyman has been shown that he does not represent God on earth to her as the other man did. The patient is in excellent contact and gives a clear retrospective account of herself. She has fair insight and with the affective admixture and the improved understanding of the family, I believe she will adjust herself satisfactorily as long as home conditions are favorable.

DISCUSSION

DR. C. M. CAMPBELL: It is certain that the contents of her ideas are closely related to the problems of her life. As to how far it is possible to explain the complete breakdown on the basis of the problems thus revealed, there might be a difference of opinion; her physical equipment may have been reduced to a lower level. The episode occurred in a perfectly clear setting; the patient knew exactly where she was. If she had been confused and disoriented, the condition would have been a delirium with a strong religious coloring. We

may find that as the emotion subsides she will get a certain insight into her past experiences. I think the prognosis is more favorable because the onset was quite acute.

DR. D. GREGG: Why did you eliminate the menopause when a partial hysterectomy had been done?

DR. HERMAN: Because there had been no flow and no important symptoms, and I should have added, because of the absence of any sex desire following this operation. Her sex life practically ceased a few months after the operation.

A CASE OF MORBID FEAR. DR. C. MACFIE CAMPBELL.

I wish to demonstrate a case of morbid fear which has lasted for one year. The patient claims that he was held up one night, and gives peculiar details of this episode, for which there was no corroboration, and which probably was of the nature of a fantasy. He claimed that since then he has been afraid of the "black hand," and finally refused to leave his home. The one association he gave for the "black hand" was a reference to a school-mate whose father was killed by an Italian society. The relationship of the mechanism of the case to the obsessive mechanism on the one hand and the schizophrenic type on the other, is of special interest.

AFFECTIVE REACTION TIMES. DR. F. L. WELLS.

Experiments were described in which visual and olfactory stimuli having various affective values were presented and the subject was requested to indicate as soon as practicable the pleasantness or unpleasantness of the affect. The time required to do this was measured. In general the time of this process is about eight-tenths of a second. A moving-picture technic was illustrated for measuring the time of involuntary emotional responses, such as facial grimacing. These times appeared considerably shorter than the voluntary reactions measured, about one-quarter of a second.

DISCUSSION

DR. H. C. SOLOMON: The facial grimaces might be thalamic reflexes, independent of actual emotional states.

DR. WELLS: This is the fact which necessitates controls of an introspective nature such as have been described.

THE SPINAL FLUID SUGAR. DR. BERNARD J. ALPERS.

In this paper are presented the sugar estimations in 421 cases of mental and nervous diseases together with some observations on apparently normal individuals. The sugar estimations in the spinal fluid were done in every case by a modification of the Benedict-Osterberg method for the quantitative determination of the sugar in the urine, modified by us for use in spinal fluid work. Each determination was compared with that of another worker who used the method of Folin. The results by these two methods varied only from 2 to 5 mg. per 100 c.c. of spinal fluid.

In our series, thirty-three cases were chosen as apparently normal in that no physical defects could be found in the somatic system. In this group the spinal fluid sugar varied between 53 and 84 mg. per 100 c.c. Most of the determinations fell between 53 and 68 mg. per 100 c.c.

Determinations were made on thirty-five cases of epidemic encephalitis, the average figure being 82 mg. per 100 c.c. The mean was found to be 84.5 mg. per 100 c.c. Our opinion is that the test is of distinct diagnostic value, but is not pathognomonic. Other conditions may give spinal fluid sugars fully as high as epidemic encephalitis.

Twenty-five cases of untreated general paralysis showed no increase in spinal fluid sugar, the average being 65 mg. per 100 c.c. Several cases of untreated general paralysis showed sugar determinations as high as one obtains in epidemic encephalitis.

The sugar in treated cases of general paralysis is not increased but is lower than that of untreated general paralysis, as shown by determinations in 163 cases.

Twenty-one cases of dementia praecox showed an average spinal fluid sugar of 80.1 mg. per 100 c.c. One case gave a sugar reading of 103 mg. and another 123 mg. per 100 c.c. Our conclusion is that here is another condition that may give a spinal fluid sugar as high as in epidemic encephalitis though not so uniformly.

We found the sugar in manic-depressive insanity to be normal. Two cases of diabetes mellitus gave sugar determinations of 123 and 189 mg. per 100 c.c.

Of numerous miscellaneous conditions many showed a greatly increased sugar content in the spinal fluid.

THE USE OF TRYPARSAMIDE AT THE PSYCHOPATHIC HOSPITAL.

Dr. H. C. Solomon.

Tryparsamide is a drug of the arsenic series which was compounded at the Rockefeller Institute in 1916 by Jacobs and Heidelberger cooperating with Brown and Pearce in their work with experimental syphilis. This drug, according to the reports of Brown and Pearce, has a marked affinity for the nervous system, and they find that in experimental trypanosomiasis it has quite remarkable curative powers. Similarly its effect on African sleeping sickness appears to be most satisfactory. Loevenhart, Lorenz, Blackwenn, and Hodges reported the results of their experience with this drug in neurosyphilis as unusually good. The chief difficulty in its use is its tendency to produce amblyopia. As a rule this amblyopia is fleeting, but occasionally it leads to permanent impairment of vision.

In June, 1923, the Rockefeller Institute released a quantity of the drug to Dr. J. B. Ayer at the Massachusetts General Hospital, and to us at the Psychopathic Hospital. We have been using it since that time, and have had experience with about seventy cases of all types of neurosyphilis.

The object of this report is to call attention to the drug and the work that is being done with it, rather than to talk of results. We feel that our experience has been too limited to allow us to make any definite statement. However, it is interesting to note that the drug does something in cases of neurosyphilis that no other drug in our experience has done; that is, in every case of our series, without exception, ten injections of this drug have caused the cell count in the spinal fluid to become negative. In this series there were a number of cases that had been under treatment for a long period of time with other medicaments, despite which there was a pleocytosis, but this responded in every instance to the use of tryparsamide. Another striking feature is that nearly all patients develop a great sense of a well-being when the drug is used and many gain weight.

Without attempting further discussion of the results, we would merely summarize by stating that as the result of our experience, we have great interest in the continued use of the drug.

DISCUSSION

Dr. J. B. Ayer: We have treated about twenty patients at the Massachusetts General Hospital. We have tried to select particularly patients who have done rather poorly under other forms of treatment, thinking those a better test for the drug. Thus far we have seen nothing that could be called a brilliant result; but we have been using it only since June. We have not seen any general paralysis become normal or even approach normal. As to the ease of giving the medicine, we agree with Dr. Solomon. It is easy and causes no reaction in any case. We have had two patients who have shown eye symptoms. One of these, however, would have developed symptoms anyway. The other I have treated since 1916 and I suspected that he had general paralysis. He has had slight symptoms all these years, and when under treatment with tryparsamide optic atrophy developed for the first time (this is the first eye trouble we have seen in him); it seems a little as if the medicine might have something to do with it. The other patient with one eye could not see ordinary print. The next day I had his eyes examined by an ophthalmologist, and after treatment he could see better than he ordinarily could. That was a transient amblyopia. Whether this was due to the tryparsamide or to disturbed circulation I do not know. Either of these cases may be associated with the medicine. Again, I do not think we ought to judge it yet; it is too early. Having read the reports of Lorenz, it seemed as though we ought to get something better than we have in the five months we have used it. We are going to continue with a new supply of the drug, for it seems to be safe.

A Physician: Did not the work done by the U. S. Public Health Service show a higher percentage of improvements than the Lorenz series? And how many treatments have been given?

Dr. Solomon: Work by the Public Health Service on amblyopia is entirely new to me. As to the length of treatment, Lorenz says it should be taken as long as is necessary even if it requires years. Moore and Keidel varied the technic of Lorenz by eliminating the rest period; sometimes eighteen, twenty, or twenty-five injections were needed before any change was noticeable.

FURTHER STUDIES IN BASAL METABOLISM. Dr. Karl M. Bowman, and Dr. G. Philip Grabfield.

During the past two years over four hundred determinations of basal metabolism have been made on hospital cases. The results in the first fifty cases were published in the Archives of Neurology and Psychiatry (March) 1923. At that time we called attention to the fact that low basal metabolism was common and that few high readings were found. The result of further study has been to confirm the previous findings. We would again call attention to the fact that to obtain the true basal metabolism all authorities insist that the patient must be in complete physical and mental rest. Therefore, it seems that a number of our findings are probably too high.

The results of our findings may be briefly summerized as follows:

Seven cases in which we found no evidence of mental disease or defect were all within the normal limits of plus or minus 10 per cent. and this affords us a good control for our other cases. Further study in the organic psychoses did

not confirm the tendency toward low findings reported in our previous article. A number of definitely increased rates were found in such conditions as general paralysis, lethargic encephalitis, etc. There was however marked variability in the organic psychoses, some being high and others low. In schizophrenia, there was found a definite tendency toward low readings, over one third of the cases being less than minus 10 per cent. This confirms our previous observations. In the affective psychoses, the basal metabolism was usually within normal limits, the excitements were mostly minus readings and the depressions mostly plus readings. Cases of mental deficiency showed a slight tendency toward increased readings but were mostly normal. This is of interest because of the common feeling that hypothyroidism may be a factor in mental deficiency. In epilepsy, there was a definite tendency toward a low basal metabolism, over half of the cases showing readings below minus 10 per cent. In the cases of psychoneurosis and psychopathic personality, the basal metabolism was usually within normal limits.

DISCUSSION

DR. O. J. RAEDER: I was interested to hear Dr. Bowman's results in the cases of feeblemindedness. I am engaged in that work with Dr. Fernald at Waverley, and we have had a number of cases under treatment. In a general way we have noticed that in a number of cases there has been a great deal of improvement, both mental and physical, under treatment with thyroid and iodin, and in others with pituitary. I would like to ask Dr. Bowman whether there was any one particular type of feeblemindedness studied in his series.

DR. BOWMAN: I cannot say off hand, but most of these cases, I think, were adults or persons over 15 years of age, and there were no definite cases, as I remember at the moment, that were regarded as cretins or mongolian idiots. There were no particular physical findings about most of these cases; we had a number which seemed to be rather definite endocrine disorders, exophthalmic goiter, etc., but those are not included in the results reported.

CHICAGO NEUROLOGICAL SOCIETY
JOINT MEETING WITH THE CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

December 3, 1923

DR. JOHN A. CAVANAUGH, *President of the Chicago Laryngological and Otological Society, in the Chair*

SYMPOSIUM ON INFLAMMATIONS OF THE BRAIN AND THE MENINGES OF OTORHINOLOGIC ORIGIN

PATHOLOGY. DR. JAMES P. SIMOND. (By invitation.)

Four inflammatory processes occur inside the cranium which result frequently from inflammation in the middle ear or sinuses of the nose: thrombophlebitis of the dural sinuses, extradural abscess, meningitis and brain abscess. It has been difficult to get reliable statistics indicating the percentage of cases of otitis media and sinusitis that become complicated by intracranial inflammation. Hegener studied 5,000 cases in Munich and found that in 0.5 per cent. of injections of the middle ear, intracranial complications resulted. Ninety-one per

cent. of those brain abscesses that complicate otitis media are associated with the chronic form and only 9 per cent. with the acute form, so that brain abscess as a complication of inflammation of the middle ear occurs less frequently in children than in adults. Heimann analyzed 570 cases of brain abscess due to otitis media and found 457 due to chronic middle ear infection and 113 to the acute form. In reports of 25,394 necropsies collected from the literature there were 205 cases of abscess of the brain complicating inflammation of the middle ear, and twenty-two complicating infections of the nasal sinuses; of 900 cases of abscess in the brain complicating otitis media collected from the literature, 565 were in the temporal lobe and 320 in the cerebellum. In four cases there was an abscess in both the temporal lobe and the cerebellum; in two, abscess of the pons; in one, abscess in the peduncles of the brain, and in two, abscess in the occipital lobe. This indicates that abscess of the temporal lobe is a much more common complication of otitis media than abscess in the cerebellum. Dench collected 202 cases, 102 of which were in the cerebellum and 100 in the cerebrum. It is difficult to understand why there is such a variance between his statistics and those of other investigators.

Intracranial involvement complicating inflammation of the nasal sinuses has been studied by Adson at the Mayo Clinic, who reported twenty-six cases of brain abscess; of these, eight complicated disease of the frontal sinus, five inflammation of the middle ear, and the others were either traumatic or metastatic. Thompson was able to collect forty cases of inflammatory process complicating infection of the sphenoid sinus. Of these, thirty were meningitis, thirteen of them with, in addition, a thrombophlebitis; one was an intracranial abscess and one encephalitis, the others being classified under names too indefinite to permit interpretation.

The question of the pathways by which infection passes from the nasal sinus or middle ear to the brain is probably better left for discussion with pathogenesis. In passing, brief mention may be made of the various pathways by which infection may spread from the nasal sinuses and middle ear to the intracranial spaces: first, by direct extension through the dura mater; second, by thrombophlebitis, usually, of course, involving the sinuses of the dura, and third, by the lymphatics. This may occur indirectly or may be more direct. The work of Key and Retzius, and of Cuneo and André shows that there are rather close relations between the lymphatics of the nose and sinuses and the subdural spaces.

Of the inflammatory processes that occur inside the cranium as complications of infections of the nasal sinuses and the middle ear, there are only two that I shall discuss: leptomeningitis and abscess of the brain. Leptomeningitis arising in this manner begins locally and the source of the infection can usually be found by examining the dura at the base of the skull. If the infection of the meninges comes from the middle ear, one finds definite hyperemia and edema of the dura over this portion of the temporal bone with, as a general rule, a definite fibrinous exudate on the upper surface of the dura. The presence of this exudate indicates a definite tendency to wall off the infectious process and limit it to the vicinity of the bone through which it is entering the cranial cavity.

A pathologist is tempted to digress somewhat and consider some of the peculiarities of inflammation that result from the type of tissue in which the process occurs. When infection spreads from the middle ear into the cranial cavity there is an attempt, usually unsuccessful, to wall off the infection. When the infecting micro-organisms get free in the cerebrospinal fluid they are in a

tortuous space lined with epithelium and filled with a fluid which circulates more or less. The infection has an opportunity to spread widely. It has seemed to me possible that, if the walling off is successful, instead of a meningitis developing, the infecting micro-organisms might pass into the brain substance and cause an abscess. It is not impossible that some abscesses of the brain are the result of the successful walling off of the inflammatory process from the subdural space as it extends from the lesion in the bone to the cranial cavity. In cases of brain abscess of this origin that I have seen, there was a definite adhesion, usually fibrinous, but if of sufficient duration fibrous, between the brain and the point of entrance of the infection from the petrous portion of the bone.

If the infection begins as an otitis media, the complicating abscess in the brain is nearly always in the temporal lobe or the cerebellum; it is more likely to be in the cerebellum if the mastoid cells are also involved. If, on the other hand, the abscess is the result of an infection from the frontal sinus, then it is more likely to be in the frontal lobe, the so-called silent area of the brain.

The gross appearance of brain abscess varies with the location and duration of the lesion. If the abscess is the result of an infection with one of the ordinary pyogenic cocci, the pus is usually thick and creamy. If the abscess is the result of some anaerobic micro-organism the pus is thin and watery. In any case it is usually greenish owing to the liberation of sulphide of iron from hemoglobin. Abscesses of the brain sooner or later develop a membrane. This is usually definite by the third week and may become very dense. Dr. Hassin has reported a case of abscess of the brain in which the capsule was as dense as the dura mater itself. What is the origin of the capsule? In an abscess in which the infection dies out and organization begins, the process of organization is initiated and carried to completion by the cells of the tissues surrounding the lesion. In the brain substance around the abscess there are four kinds of cells: parenchymatous, glial, connective tissue, and endothelial. As ganglion cells have no proliferative power they can be eliminated from consideration at once. Although glia cells are present in great abundance, they are incapable of completely organizing any large area of tissue destruction. The only connective tissue cells are those that enter the brain with the blood vessels and these, while they have great power of regeneration, are too few for successful and complete organization. It is from proliferation of both the glial and the connective tissue cells that the capsule of the abscess is formed.

One of the most interesting features of abscesses of the brain is that on the inner surface of the capsule there are great numbers of cells known as Gluge's or granule cells. These are large phagocytic cells which contain many granules, largely lipoidal in nature. Tanaka and Holmes have claimed that these originate from the glia; others claim that they are endothelial in origin and are derived from neighboring blood vessels. The latter seems to be the more logical opinion. One reason for discounting the glial theory is that originally the glia cells come from ectodermal cells and the descendants of epithelial cells are not phagocytic, whereas the endothelial cells usually are phagocytic. It seems probable therefore that these granule cells are of mesenchymal origin. Teleologically, pus is the result of liquefaction necrosis, and in most tissues when this occurs the necrotic material is transformed into soluble substances which can be readily resorbed. Brain tissue is rich in lipoids, cholesterin and other substances of that type, which are not readily soluble. As a result it is necessary that the detritus of a brain abscess be removed by some process other than resorption. It is for this purpose that these large phagocytic cells enter the area of infection and abscess formation.

As to the fate of brain abscess, occasionally the infection dies out, the abscess becomes thoroughly walled off and may become calcified more or less completely. That is a very rare outcome. In a very high percentage of cases, brain abscess leads to fatal termination. Death may result from: (1) breaking through of the wall of the abscess and spread of the infection; (2) increased intracranial pressure; (3) rupture into the subdural space or ventricles of the brain with resultant meningitis. It is interesting to note that Dr. Eagleton, in his comprehensive monograph, has advanced a new theory concerning the "stalk" of a brain abscess. This is a peculiar little process that projects from one part of the abscess and has usually been taken as a sort of index finger pointing to the source from which the infection reached the brain. Dr. Eagleton considers this stalk to be an attempted perforation, which has more or less healed. Sometimes a perforation is successful and the patient dies of meningitis. Finally, it may be mentioned that thrombophlebitis of a neighboring sinus may induce a complicating embolic pneumonia and death of the patient.

General Diagnosis. Dr. Julius Grinker.

Meningitis.—Chills, fever, severe headache, cerebral vomiting, clouding of consciousness, and stupor, perhaps terminating in coma, probably indicate cerebral meningitis. It is well to emphasize that the discovery of a possible primary focus is no proof that an existing meningitis is secondary to it; the primary focus may coexist with a meningococcus meningitis.

The symptoms of meningitis may be divided into: (*a*) Irritative phenomena: headache, insomnia, general hyperesthesia and hyperesthesia of the special senses, nystagmus, twitchings of muscles, contracted or unequal pupils, spasticity of the muscles of neck, abdomen, and back, spastically flexed legs, general convulsions, Kernig and Brudzinski signs and mental irritability. (*b*) Paralytic phenomena: vomiting, constipation, and incontinence of urine; the pulse, retarded in the earlier phase because of vasomotor irritation, toward the end becomes rapid on account of vasomotor paralysis; strabismus; pupillary narrowing giving way to dilatation, with perhaps loss of both light and accommodation reflexes. Finally, spasticity becomes replaced by flaccid paralysis.

Infectious Sinus Thrombosis.—In addition to the general symptoms of fever and chills, headache, vomiting, restlessness and delirium, with, sometimes, convulsions and coma, there are local signs of sinus thrombosis. In thrombosis of the superior longitudinal sinus there may be nosebleed and edema at the root of the nose; in cavernous sinus involvement there occur edema of eyelids and conjunctiva, choked disk, proptosis, oculomotor or abducens paralysis; when the transverse sinus is involved, there will be found edema over the mastoid process and the jugular vein feels like a cord.

Brain Abscess.—The symptoms of epidural, subdural and superficial brain abscess are similar to those found in pachymeningitis and leptomeningitis. Of greater importance are the deep abscesses, found in order of frequency in the temporosphenoidal lobes, cerebellum, and frontal lobes.

As in the symptomatology of brain tumor, the symptoms may be divided into general and focal. The general symptoms are much like a combination of brain tumor with meningitis, and may be subdivided into: (*a*) those due to increased intracranial pressure, and (*b*) those caused by the inflammatory process in the brain.

Differential Diagnosis.—Otitic or rhinologic meningitis can be definitely differentiated from other forms of meningitis by complete examination of the spinal fluid. In meningism the meningeal symptoms are quite as acute as in true meningitis, but the spinal fluid is only increased in amount and shows no pathologic change. The patient usually recovers after a single spinal puncture. In sympathetic meningitis there are meningeal symptoms, but the spinal fluid is sterile, although the pressure may be up to 400 mm.; there is also an increase in albumin and polynuclear cell content. As this type of disease occurs in connection with brain abscess, with or without mastoiditis or lateral sinus disease, it may help positively in the diagnosis of brain abscess and negatively in excluding otitic meningitis.

Differential points between meningitis and brain abscess are: In abscess, the temperature is low, or subnormal, the pulse is slow, Kernig sign is unusual, focal signs are usually present, the spinal fluid may be normal, though pressure may be increased and the fluid may be turbid because of increased cellular content, and the course is like that of brain tumor.

Focal Signs and Symptoms. Dr. Hugh T. Patrick.

I shall confine my remarks to abscess, as the focal signs of septic meningitis and serous meningitis are uncertain. Focal signs of abscess of otorhinologic origin are the same as those of abscess of any other origin and the focal signs of abscess are practically the same as those of any other pathologic process. I am strongly inclined to agree with Oppenheim when he says that in brain abscess focal signs "are present in the majority of cases but are not always recognized and evaluated." Incidentally, I wish to add that in locating a brain abscess, focal signs should take precedence over the locus of a known source of infection. For instance, frontal sinus or ethmoid disease generally causes frontal lobe abscess, but if the neurologic signs point to the temporosphenoidal lobe, the abscess should be sought there. Abscess of otitic origin is nearly always in the temporal lobe or cerebellum, but if focal signs point to the rolandic region, in all probability the abscess is there.

Ocular Findings. Dr. George F. Suker (by invitation).

I shall limit myself to fundus changes. The ocular findings in brain complications due to ear disease, particularly abscess, are few and simple. They are no different from the intraocular findings of any other brain lesion. We cannot tell definitely from fundus lesions whether we are dealing with brain tumor, abscess, or meningitis. There are two findings of note: neuritis, and papilledema, and, frequently, these two are confounded. Papilledema is the result of extraocular pressure either orbital or intracranial. Neuritis is an inflammation, and the swelling accompanying it is secondary to the inflammation. Neuritis cannot exist without this swelling; papilledema may exist for months without interference in the visual acuity or visual fields, but not neuritis. Papilledema is a congestion and starts, as a rule, on the nasal side of the disk. The disk begins to have a halo, the incipient edema, which is not present in neuritis. The disk edges are clear cut in papilledema, not so in neuritis. In papilledema the vessels are clear and distinct throughout their entire course; in neuritis they are hazy and their continuity is more or less disturbed because of the exudate. The beginning of an optic neuritis, as a rule, is manifested by the early covering of the physiologic cup, which remains visible for a long

time in papilledema. Visual fields and vision are always interfered with in neuritis, not in papilledema; at least, not until a secondary neuritis supervenes.

As a rule, if both sides are involved, you will find more intense fundus involvement on the side of the abscess. This is not always true; you may have papilledema on the opposite side. The fundus changes are not proportionate to the size or location of the abscess. Optic neuritis may be due to one of two things: pressure by the abscess, and a toxic effect that is manifested first along the edge of the disk.

The fundus changes with sinus thrombosis as a result of ear disease furnish perhaps the most characteristic picture. As a rule, there is a papilledema with a pronounced "halo." If you suspect a sinus thrombosis (particularly cavernous) and find this halo you can almost rest assured that a thrombosis has occurred.

There are five points with which to evaluate the fundus findings in any intracranial complication: (1) absence of findings does not indicate absence of intracranial lesions; (2) the changes do not indicate the character or location of the lesion; (3) the changes have no bearing on the prognosis as to life; (4) fundus changes in the absence of cerebral manifestations are of great diagnostic value in suspected intracranial complications; (5) fundus changes may appear in any type of intracranial disease.

Spinal Fluid Changes. Dr. Harry A. Singer.

In many cases of otitic infection associated with signs of meningeal irritation, determination of the actual anatomic changes in the meninges is frequently difficult. When the prognosis and course of treatment are guided by or are dependent on the type and extent of the meningitis present the spinal fluid findings may be of great importance. It was, therefore, deemed worth while to attempt to evaluate the cell count and the bacteriology, in order to aid the clinician in the interpretation of spinal fluid findings. The data and conclusions are based mainly on laboratory, clinical, and postmortem findings in cases treated at the Cook County Hospital in the past five years.

A negative Nonne or Pandy test and a normal cell count practically rule out meningitis. When, however, there is an increase in the globulin and cell content of the spinal fluid, associated perhaps with the presence of a microorganism, the determination of the type of meningitis is frequently a matter of controversy. Clinically, the attempt is usually made to distinguish between serous or protective meningitis, in which surgical intervention is urgently indicated, and the purulent or suppurative type in which operation is usually of little or no avail. The distinction between the two is said to lie in the bacteriologic findings; the absence of organisms indicates a protective, or sympathetic meningitis, their presence points to a septic or purulent process. Although this division is valuable, yet, from a practical standpoint, it has many shortcomings.

In many cases which ultimately were found to be diffuse suppurative meningitis, we have failed to detect organisms early in the disease, even when the fluid was turbid. This applies particularly to cases in which a single specimen was submitted for bacteriologic examination. If the spinal fluid is examined on successive days, we rarely fail to recover organisms from the spinal fluid in pyogenic cases. But inasmuch as bacteriologic reports in suspected otitic meningitis are required immediately, conclusions must be drawn from the examination of one specimen and frequently from a coverglass preparation alone.

It does not necessarily follow that the isolation of organisms from the spinal fluid indicates the presence of diffuse meningitis; many patients recover in whom organisms have been demonstrated. Furthermore, at the necropsy table we find that in some the meningitis is distinctly circumscribed, death having resulted from other causes, such as abscess or pneumonia.

From a therapeutic and prognostic standpoint it is important to decide whether we are dealing with a case of circumscribed meningitis or one in which the inflammation is diffuse. Given a case in which an otitic infection is associated with signs of brain abscess and evidences of meningeal irritation, in which the spinal fluid findings indicate the presence of an inflammatory process, the type of meningitis more or less determines the prognosis and with some men the treatment to be followed. The more radical otologist and neurologist would advise operation, the more conservative would ask for the bacteriologic findings. But since so many cases of diffuse meningitis are associated with negative smears and cultures and, not infrequently, a case of circumscribed meningitis yields organisms, the problem would hardly be satisfactorily settled by a bacteriologic examination.

In the presence of a very low or an extremely high cell count, the course to follow is obvious. But it is the borderline cases in which the count is neither low nor high that require consideration. Since cases of brain abscess are frequently associated with meningitis and it is this type of intracranial otitic complication which is most perplexing, the figures for this study were chosen from such cases. In reviewing the brain abscess histories of the Cook County Hospital during the past five years, I was able to gather but ten records which fulfilled the requirements. A brief summary of the histories of a few representative cases will indicate the value of the figures given and the conclusions arrived at.

REPORT OF CASES

Case 1.—A girl, aged 9, developed bilateral otitis media and left mastoiditis following an attack of scarlet fever. Left mastoidectomy was performed. Signs of meningitis developed and spinal puncture showed 240 cells and no organisms. On the following day, just before operation, another spinal puncture showed 37 cells. Right mastoidectomy was then performed. The following day the cell count was 250 and signs of meningitis disappeared; they reappeared a month later, when apathy and visual aphasia were also noted. The cell count at this time was 650. The diagnosis of temporosphenoidal abscess was made; the abscess was opened and its contents evacuated. The patient left the hospital in good condition able to read and write.

Case 2.—A woman, 24 years of age, presented symptoms and signs of mastoiditis, complicated by brain abscess and evidence of meningeal irritation. The cell count was 94; no organisms were found. A radical mastoid operation was performed, the brain abscess was opened and drained, following which the meningeal signs disappeared. Two months later the symptoms of meningitis reappeared. Spinal puncture performed on the day of death yielded 21,400 cells per cubic millimeter. Necropsy revealed diffuse suppurative leptomeningitis.

Case 3.—A man, aged 43, presented classical signs and symptoms of meningitis; the cell count was 3,110 (96 per cent. polymorphonuclear cells); antimeningococcus serum was given. Otitis media was found and an operation was performed. On the day after the operation the cell count was 2,300; six days after the operation it had dropped to 510. In this last specimen streptococci were found on a cover-glass preparation which on culture were

found to be hemolytic in type. At a subsequent examination no signs of meningitis were found. The cell count at this time was 1,880. Gradually there developed signs of brain abscess, localized in the right cerebellar lobe. The abscess was opened and drained, but the patient died on the following day. Postmortem examination revealed no evidence of old or recent diffuse meningitis, the inflammation of the meninges being entirely local.

Case 4.—A man, 23 years of age, with otitis media, developed headache, vomiting and rigidity of the neck. He was operated on for left mastoiditis, and later developed signs of brain abscess. Organisms were found in smears and cultures of the spinal fluid before and after operation. The patient was treated with antimeningococcus serum and left the hospital without signs of meningitis but with findings pointing to the presence of a brain abscess. The cell counts on the spinal fluid during his stay in the hospital were: 4,000, 9,000, 6,000, 8,000 and 4,000. As the patient left the hospital in fair condition, it is reasonable to assume that at no time was the meningitis diffuse, in spite of the fact that the cell count rose as high as 9,000.

COMMENT

In ten cases of otitic brain abscess with signs and symptoms of meningeal irritation, but in which the subsequent clinical course or postmortem findings indicated that the meningitis was localized, there was an average cell count of 2,200, the lowest being 60 and the highest 9,000. Two cases gave a count under 100; four between 100 and 1,000, and four between 1,000 and 10,000. In the three cases in which diffuse meningitis followed, as corroborated by postmortem findings, the counts were 21,000, 54,000 and 56,000, respectively.

The striking feature is that counts of from 3,000 to 9,000 may be associated with circumscribed meningitis. It appears that the cell count is a rough index to the extent of meningeal involvement and should be taken into consideration with the bacteriologic findings.

In the past two weeks I have had occasion to observe two cases of meningitis, both of which showed organisms on direct smear and in culture. The first, a patient of Dr. Joseph L. Miller, presented a textbook picture of meningitis. The cell count on entrance was 8,800. At the necropsy, three days later, the leptomeninges everywhere were filled with purulent exudate. The second case, on the service of Dr. John Favill, also presented a picture of meningitis, but the spinal fluid contained between twenty and thirty cells. Organisms were found on direct smear and were identified by culture as Friedländer's bacilli. An intraspinous injection of antimeningococcus serum was given. The following day the count rose to 800, probably in part as a result of the chemical irritation caused by the serum (aseptic meningitis). Serum treatment with repeated spinal drainage was carried on for a few days when the patient became symptom free and walked out of the hospital apparently in good health. The presence of organisms is not infrequently associated with low cell counts and these cases, in which, apparently, the inflammation is not widespread, constitute the bulk of reported cures.

CONCLUSION

It appears justifiable to conclude that the cell count is an important adjunct in the diagnosis of the type and extent of meningitis and should be taken into account with the bacteriologic findings in the interpretation of laboratory reports on spinal fluids.

OPERATIVE TREATMENT. DR. WELLES P. EAGLETON, Newark, N. J. (by invitation).

The treatment of meningitis and suppurative brain conditions has not kept pace with advances in nonsuppurative conditions.

Brain Abscess.—From textbooks one might conclude that from 20 to 60 per cent. of temporosphenoidal and about 50 per cent. of cerebellar abscesses recover; yet a compilation including all cases reduces the recovery rate to 33 per cent. and 10 to 15 per cent. respectively. If a brain does recover from suppurative disease it is usually restored to usefulness.

When and Where to Operate: Operations should be performed in a hospital by a specially trained team and only in such hospital. I plead for the development of a department of head surgery in every large hospital and in every eye and ear institution. This department should consist of a chief and three assistants. It should have at its disposal an operating room, a trained nurse, a technician and a laboratory man. This is a hospital in itself and yet, if we are to get these patients well, every one of them may be needed.

Plan of Work.—First, a minute history should be taken. Simply to record headache, dizziness and vomiting, means nothing in the diagnosis of early suppurative diseases of the brain, but every patient who enters the hospital with a running ear and certain vague neurologic symptoms should be subjected to a complete neurologic investigation before a simple mastoid operation is done. The man with a nasal discharge who says, "I have had a headache off and on for three years, but during the last two weeks I just can't stand it," is not simply a case in which to open the frontal sinus. I believe this neurologic examination and complete history will diagnose a majority of brain abscesses very early. There is a long line of symptoms, all of which are impossible to define, which yet make up a picture that, to a trained mind, indicates intracranial disease. I believe the surgeon himself should be competent to conduct this neurologic examination. You would not respect an abdominal surgeon who is compelled to send for an internist to diagnose the meaning of a pain in the left iliac fossa. The neurologist is in the habit of dealing with functional lesions, degenerative lesions, cerebrospinal syphilis, in which he frequently encounters headache and vomiting; consequently, they do not make the impression on him that they would on the surgeon, for the surgeon is in the habit of dealing with suppuration. The surgeon's attitude is: "Is this a surgical lesion? If so, it is my job."

When to Operate: As soon as all data are obtained and every technical procedure that may be encountered during the operation has been provided for, and then immediately. Four times I have seen patients with brain abscess die who should have recovered, because of delay until the following day.

My technician takes the visual fields. She is a highly intelligent woman who knows nothing about medicine, but does know how to put down the findings, no matter if they are incomprehensible to her. The field of vision in a temporosphenoidal abscess depends on the position of the abscess. The contraction is caused by the abscess compressing the fibers running from the cuneus to the primary optic center. The hemianopia comes and goes. I have seen complete hemianopia for colors on one day and the next day it was gone. The text books say the temporosphenoidal lobe is "a silent area." It is not silent; it always gives an indentation of the visual field.

A roentgenogram should be taken of every suspected brain abscess. I have observed a case of abscess filled with air; this does not occur often. Experience has shown that a large percentage of abscesses of the brain associated with ear disturbances are accompanied with clouding of one or more nasal sinuses.

Lumbar puncture in localized suppurative diseases of the brain is dangerous. We are so in the habit of doing lumbar punctures in meningitis, in cerebrospinal syphilis and degenerative lesions that we forget what may result from a lumbar puncture in cerebral displacement. The brain is held together chiefly by blood vessels and if there is an abscess in the cerebellum, the whole structure is displaced beyond the median line. If it happens to be in the frontal lobe that does very little damage, but if it happens to be somewhere near the brain stem, the blood vessels are displaced. They have stood the strain because the displacement has been gradual. If cerebrospinal fluid is withdrawn suddenly these displaced blood vessels may rupture, simply from taking away the pressure. They rupture almost invariably in one place, around the pons. I know of four deaths that have occurred in the last three years as a result of lumbar puncture for diagnosis. If we perform lumbar puncture, we should do it very carefully, especially when we suspect cerebellar abscess; we should be prepared—particularly if the patient begins to breathe badly—to go ahead with the operative procedure. If the hemorrhages into the pons are small the patients do not die quickly, as they do when the medulla is forced down through the foramen magnum, but they have Cheyne-Stokes respiration and die two or three days later, but they die from the lumbar puncture. The fluid should be examined immediately.

How to Operate: Make a large flap. I have missed two abscesses that should have recovered. The abscesses themselves were just beneath the dura and when I passed an exploratory knife through the dura I went right through the abscess. There are certain difficulties about the large flap. One is that in abscess we are dealing with increased pressure. If we have a big flap we have to reduce the pressure or we will have brain herniation. In one of my cases in which I made a large flap, the man was completely paralyzed in one arm. He had a running ear and it looked as if it was a case in which it was possible to use a small opening through the mastoid region, but I decided to make the big flap. I did so, and in turning it down came on a collection of pus. I should not have found this through a small opening.

Cerebral surgery is hard manual labor so far as the bone surgery is concerned, and must be carried out with the greatest rapidity and the least amount of bleeding possible. When the flap is turned back, the intradural part of the operation must be done with the greatest delicacy and the most painstaking technic, as an ophthalmologist extracts a cataract.

I want to call attention to the necessity of wide exposure of the cerebellum if we are to find the abscess in the different parts of the cerebellum in which it occurs. In ninety-three necropsies on cerebellar abscess, the total number which would have been accessible to exploration from in front of the sinus was forty-one; from behind the sinus twenty-four. The total probably inaccessible by either route was eleven and the total positively operable was seventeen. In other words, out of forty-one cases, if we had stuck a knife in front and behind we could not have struck twenty-eight of them; and yet every textbook says to explore from the front or in behind the sinus.

Meningitis.—This is an involvement of the cerebrospinal fluid circulatory system and while my results in the treatment of brain abscess have been somewhat disappointing, recently the results in suppurative meningitis have improved because I have altered my conception of meningitis. At the beginning of the process, suppurative meningitis is localized and does not involve the whole cerebrospinal circulatory system.

Cerebrospinal fluid is necessary for the proper functioning of the brain. The cerebrospinal fluid system contains within itself the protective mechanism of the brain and it also plays a large part in the repair of injury of the brain; when suppuration attacks the leptomeninges, the inflammation has attacked a vital part. The rise in temperature is caused by the fact that while the blood of an animal that has been infected is only slightly more toxic than the blood of a normal animal, the effusions in the tissues from that infection are highly toxic; consequently, when a localized infection occurs, the cerebrospinal fluid becomes toxic and the patients develop toxic symptoms. The two facts that the septic symptoms are due to an alteration in the character of the fluid, plus the fact that nearly all cases of meningitis in the beginning are localized, have altered my conception of the surgical treatment of meningitis. The localized infection in the subarachnoid space remains relatively quiescent sometimes for days and days before it overcomes the patient.

If this localized collection of fluid is evacuated (you cannot drain the circulatory system), if you let out a localized collection of fluid which is highly toxic and contains micro-organisms (sometimes with a low cell count; in the lumbar region, as low as 48 and sterile), the case may recover provided you replace that fluid with a simple solution that contains calcium salts at the temperature of the body. During the last two years I have secured a few recoveries because I attack the condition with relative assurance. These cases, if examined carefully, do show focal symptoms.

Cavernous Sinus Thrombosis.—In seventeen cases I have had four recoveries; the diagnosis in two is very doubtful but in the other two it is positive. These recoveries occurred simply because of another conception that came to me by accident. If cavernous sinus thrombosis is not operated on, about 7 per cent. may recover; but I know of none outside of the two I report that have recovered from surgical procedure. Cavernous sinus thrombosis occurs from infection entering either from the veins of the face, nose or throat, or from the petrosals. If a pimple of the nose or lips is incised and then squeezed, thus stimulating the extension of a thrombophlebitis, during the next few days we may have a cavernous sinus thrombosis. When the thrombosis originates from behind, it is a different picture because it does not immediately stop the return circulation and cause the eye to proptose. These cases go on for a long time without exophthalmos. One case lasted for fifty-nine days without exophthalmos. All this time the patient had an infection in the cavernous sinus. When the thrombophlebitis fills the whole sinus, of course there is a proptosis.

Some years ago Mosher described an approach to the sinus by removing the eye and the wing of the sphenoid bone and then opening in front of the cavernous sinus. I tried this, but the hemorrhage was so great as to prevent proper inspection. Recently, I had another case with proptosis, the infection having come from in front from an invasion of the ethmoid cells; when the other eye began to proptose, I tied the common carotid before eviscerating the orbit. I have tied many external carotids to stop hemorrhage from the throat and nose. The external carotid, however, does not control the circulation through the brain so I decided to tie the common carotid. I did so and then eviscerated the orbit with practically no hemorrhage, removed the wing of the sphenoid, opened the cavernous sinus from in front, passed a probe back as far as the petrous portion of the temporal bone, and the child recovered. That set me thinking and in my next case in which the cavernous sinus was infected from the petrosals, the infection having entered from behind, I did the same thing. The

explanation of these startling recoveries is simple; thrombosis, whether in a cavernous sinus or in the leg, is made worse by movement. In cavernous sinus thrombosis there is an infection inside a great venous trunk within which the internal carotid artery is pounding away and maintaining the thrombotic process; if you tie the common carotid you put the sinus at rest. Both of my cases have gone on to an uninterrupted recovery. The second case may not have been a complete cavernous sinus thrombosis because it did not cause double proptosis, but it certainly extended well out through the petrosals and involved one cavernous sinus.

If I can leave the thought that intradural surgery should be conducted by special teams who devote their whole time to this work, and that these teams should be compelled to render to the hospital every month a complete report of every case in every detail, the treatment of suppurative diseases of the brain would undoubtedly progress more than it has.

DISCUSSION

Dr. Joseph Beck: I have always profited by the work of Dr. Eagleton. My results with work on the brain have been very disappointing and I am sure that I have made many of the mistakes that have been referred to. The suggestion of Dr. Eagleton regarding the opening of the skull is excellent. I have always used electrically driven burrs and drills; but even with the perfected instruments the work is laborious and by the time the operator has reached the brain he is tired out. My experience in regard to the comparison of results in brain abscess and meningitis has been the opposite of Dr. Eagleton's. In meningitis I have no good results to report. I have operated on one case of meningitis, due to pneumococcic infection, by the cisterna magna route which recovered. This was one of eight cases; the other seven all died. The procedure mentioned by Dr. Eagleton for treatment of meningitis is new to me, but appears good. I had hoped that Dr. Suker would touch on a symptom that is of some value; namely, the Crowe-Beck sign (Beck, of Vienna), an intraocular finding in sinus thrombosis. This should be tried even if it does not prove positive in every instance. I have recently had a case in which it was of value. The symptom is elicited by pressing the region of the internal jugular vein on the affected side, or having some one else press it while one examines the interior of the eye. When this is done one can see the distention of the veins in the fundus of the eye as well as on the external temporal side.

Dr. G. B. Hassin: The most interesting phase of the brain abscess problem is the formation of the connective tissue capsule around the abscess. In a stained section from a normal brain little, if any, connective tissue is visible, the visual field being monopolized by ganglion cells, glia cells and nerve fibers. In a pathologic brain the blood vessels may become exceedingly numerous, and, in an abscess, new formed connective tissue forms a powerful membrane surrounding the abscess cavity. The question arises: Where does the connective tissue come from? Histologic studies of a capsule show that it consists of three distinct layers. The one adjacent to the abscess is made up of fibrous tissue containing few, if any, blood vessels; the layer bordering on the brain substance also contains fully developed collagen connective tissue fibers, but it is distinctly vascularized; the middle layer consists principally of hematogenous elements (lymphocytes, plasma cells, polyblasts) and fibroblasts (young connective tissue cells), scattered among numerous capillaries. The relationship between the

hematogenous elements and the fibroblasts can best be determined by experimental work. This was done by Maximow, who demonstrated that young connective tissue grows from hematogenous elements, principally polyblasts, which he considers modified lymphocytes. The histologic pictures of the youngest, the middle, layer, in my cases was so similar to those of Maximow that I feel justified in maintaining that the brain abscess capsule grows from the lymphocytes; that is to say, from the hematogenous elements.

Dr. C. F. Yerger: I have recently had experience with cases of temporosphenoidal abscess at the Cook County Hospital, in which the diagnosis rested especially on the finding of visual aphasia. Visual aphasia was first described by Freund and subsequently by Oppenheim, in 1889, and has been of immense value in the diagnosis of left temporosphenoidal abscesses; and it is possible to make such a diagnosis in suspected cases on this sign alone. Optical aphasia is characterized by the inability of the patient to name objects, although he knows what the object is used for and is able to describe the use. Ballance calls this condition anomia, and states that it is due to a lesion of the naming center, which is located in the posterior part of the left inferior temporal convolution.

Referring to Dr. Suker's statement that it makes no difference to the papilledema where a brain abscess is located, this is contrary to the experience of Ruttin and Neumann, of Vienna; they claimed that the abscess is most often accompanied by choked disk when it is situated in the posterior fossa, in contradisinction to the middle or anterior fossae.

Two of the cases reported by Dr. Singer were in my service at the Cook County Hospital. In one brain abscess case that came to necropsy, there was a normal cell count, although I do not recall how long before death the puncture was made. It makes a great deal of difference at what time the puncture was made; in the beginning of a localizing or protective reaction, there is only a relative increase in cells; at a later stage, after the inflammatory reaction has become established, there is a proportionately greater increase in cells; in the terminal stage of diffuse suppurative leptomeningitis, the cell count reaches the maximum. In one case, with the onset of a diffuse meningitis, the cell count arose from less than 2,000 to 56,000 cells; and in another case, from less than 1,000 to 20,000 cells. I have seen a count of 250 cells in a case of brain tumor, but the cells were of the lymphocytic variety; in sympathetic or septic meningitis, while there is a pleocytosis, it is of the polymorphonuclear variety. I agree with Dr. Singer, that many of these are borderline cases in which it is difficult or impossible, from the standpoint of the cell count, to determine whether the case is one of protective or sympathetic meningitis or one of diffuse suppurative meningitis. A high cell count, say above 10,000, which increases on subsequent punctures, with increasing clinical symptoms, justifies the diagnosis of septic meningitis; this diagnosis is certain if we find pyogenic micro-organisms in the spinal fluid.

Dr. J. Holinger: In what percentage of cases does Dr. Eagleton find Babinski and Kernig signs? Drainage of the subarachnoid space in several cases of beginning meningitis has yielded good results, and I think that Dr. Eagleton's explanation of these results is plausible.

Dr. George W. Boot: I have seen one symptom in a patient with suppuration of the frontal sinus which was most peculiar. So far as I know this patient did not have a frontal lobe abscess, but he had an empyema of the right frontal

sinus. When he came into the operating room he had not signed the operation permit and, when requested to do this, he turned the blank upside down. When it was turned back, the patient again turned it around. When asked why he did this he replied that he always wrote his name upside down. I then held the paper right side up and the patient wrote his name backward as well as upside down. It was not mirror writing. A week later he tried to write his name in this way and could not do so.

In my experience the most significant symptom of a left temporosphenoidal abscess has been disturbance of the center for the memory of names, the patients being unable to remember the name though they may be able to describe the object.

In the localization of a cerebellar abscess disturbances in past pointing were of the utmost value.

I have had one patient with temporosphenoidal abscess recover who had 6,250 cells, and another with 16,300 cells in the cerebrospinal fluid, so the differential diagnosis between brain abscess and meningitis by means of the cell count is difficult.

The new procedure Dr. Eagleton has outlined for cavernous sinus thrombosis certainly sounds reasonable. The condition is desperate and anything that can be done to save even one or two patients should be adopted. Dr. Eagleton made two statements that were so astounding that they seemed worthy of further study. In one he spoke of invertebrates having semicircular canals and in the other he said that the lower animals have no cerebrospinal fluid.

Referring to the two cases of temporosphenoidal abscess which Dr. Eagleton failed to diagnose because he passed the exploring instrument entirely through the abscess, Dr. Boot said he thought Dr. Eagleton would have found them had he used an instrument with two parallel blades such as that devised by Dr. Gifford of Omaha.

Dr. Hugh T. Patrick: Visual aphasia is a much rarer symptom of temporal lobe abscess than auditory aphasia, because the center for visual speech is much higher up and further back, whereas the center for auditory speech is in the temporal lobe itself.

It is a matter of extreme indifference who makes the neurologic examination in such cases so long as it is made and well made. I believe that the necessity for a thorough examination cannot be stressed too much.

Speaking of lumbar puncture, the needles customarily used are much too large. They should never exceed 1 mm. in diameter and 0.8 mm. is just as good. The small amount of fluid removed for examination makes no trouble, as a rule, but the amount of fluid which escapes afterward does cause trouble. The dura is not very elastic and the needle ordinarily used makes a hole through which the fluid continues to flow for some time. If a small needle is used and a small amount of fluid is withdrawn the bad effects of puncture, even in brain tumor, would be much less frequent.

In regard to opening the skull, I have seen de Martel operate a number of times and was much impressed with the rapidity with which he opened the skull. If Dr. Eagleton and others would use the instrument of de Martel they would find it would go through the skull as if it were a piece of cheese. I have no opinion as to whether or not this is a wise procedure.

Dr. Harry A. Singer: In cases of meningitis under observation in the Cook County Hospital during the past five years in which the patient either recovered or at necropsy showed only a localized meningitis, the highest count was below

10,000. The 16,000 count obtained in a case of meningitis with recovery which Dr. Boot cited, is probably the upper cytologoic limit in cases of circumscribed meningitis.

Dr. Wells P. Eagleton: I am glad the question regarding the presence of the Babinski and Kernig signs in meningitis has been asked. The nomenclature on meningitis should be revised, so far as symptoms are concerned. The text books say there must be a stiff neck, yet there is not a stiff neck, nor a Kernig sign, until the base is involved.

I did not say that invertebrates have semicircular canals, but that they have a well established vestibular apparatus, the vestibular apparatus being necessary in the preservation of equilibrium no matter whether standing erect or lying on the ground.

I have used the de Martel apparatus. In my opinion it is the best instrument that has ever been put on the market but, unfortunately, it makes too big a groove. The de Martel instrument is built for heavy work and works with great rapidity, but something should be developed that will give the beveled edge that is lacking when this instrument is used.

PHILADELPHIA NEUROLOGICAL SOCIETY

Regular Meeting, Dec. 21, 1923

C. M. Byrnes, M.D., *President, in the Chair*

THREE CASES OF CERVICAL RIB. Dr. E. H. Erney.

Case 1.—A woman, aged 23, had slight shooting pains in both arms, which began in July, 1923, while she was bathing in the ocean; the pains increased especially in the left arm above the elbow and were almost constant. When she raised her arms over her head the pains became more severe, and were especially noticeable at night when she was lying down. When she placed her hands in cold water she had the sensation of pain shooting up the arms. No diminution in the radial pulse occurred from traction. The cervical ribs could be felt easily. Redness of the hands developed when they were held down at her side. There were no tender spots along the course of the nerve trunks. The roentgenogram revealed a cervical rib originating from the seventh cervical vertebra on either side. The thyroid was enlarged, but other signs of hyperthyroidism were absent.

Case 2.—The patient, a domestic, single, aged 20, had a twin sister with a similar condition, and a brother was supposed to have a cervical rib. A paternal aunt had suffered with similar pains for many years, and was treated fo rrheumatism of the arms. In 1915, the patient was treated for rheumatism at a hospital for three months, and her tonsils were removed. Pain and stiffness of the neck muscles were present, and a roentgenogram of this region revealed a cervical rib. She said that the pain at that time was quite different from the pain she had had during her present illness. About six months ago, the patient began to experience severe shooting pains in each arm. The pains had grown worse, and at times were so severe that afterward her arms became weak and almost powerless. She also complained of numbness in both hands. Another symptom the patient described was pain and numbness in the feet, but she said that the pain was not the same variety as that in the arms.

Examination.—Neurologically she showed little of a positive nature. There were no pain points observed, although she was nervous and easily excited. There was no disturbance of sensation in the arms. On each side of the neck was felt a hard lump which was probably the end of a cervical rib. On testing for diminution in pulse when traction was made on the subclavian artery, with the arms extended over the head, there was a decided decrease of the blood pressure; this did not, however, increase the pain as it did in the first case. I am unwilling to ascribe this to the traction phenomena alone, as the patient had a fairly well marked mitral regurgitation which seemed to be under full compensation. The roentgenogram taken by Dr. Pfahler on March 10, 1916, revealed a cervical rib one and one-half inches long on each side.

Case 3.—This patient was the twin sister of the patient in Case 2. She had no symptoms referable to the cervical ribs, which were bilateral as shown by the roentgenogram.

Two points which impressed me were the peculiar lancinating pains with weakening influence on the strength of the upper extremity, this loss of strength not being demonstrable, and the pain resisting all therapeutic treatment, and the probability that the cervical rib is a more frequent anomaly than is generally supposed.

DISCUSSION

Dr. F. Grant: The cervical rib is one of the few causes of symptoms referable to the brachial plexus, that can be relieved by surgery. Symptoms, as a rule, may be classed under motor, sensory and trophic phenomena. The lower cords of the brachial plexus are most affected because the eighth cervical and the first dorsal nerves are angulated by the rib, and pinched between the anterior scalenus muscle and the first rib.

The three patients presented by Dr. Erney do not seem to have clean-cut cases of cervical rib. Neither sensory nor motor disturbances are characteristic; the emphasis laid on the vasomotor disturbances seem to point to a possible obstruction to the flow of blood through the subclavian vessels, rather than an involvement of the plexus. There is no question of the presence of a cervical rib, demonstrated on the roentgenogram, but the relationship of the cervical rib to the symptoms of which the patient complains are not to my mind at all clear. If the cervical abnormality is causing the complex, it must be in an early stage.

I have a case here referred to me my Dr. Potts, in which the patient was operated on three weeks ago. The patient showed motor and sensory disturbances in the distribution of his ulnar nerve. Since the operation he has recovered a great deal of power, and sensation is apparently normal.

Dr. Charles S. Potts: One point of a great deal of importance in these cases is that the symptoms are often excited by traumatism. The man on whom Dr. Grant operated first noticed the symptoms after his arm had been squeezed between the wall and a car in a coal mine. The symptoms have persisted for six years, and apparently no one has suspected the cause of the trouble. He has been accused of malingering to obtain compensation. During the war I also saw several cases at the Navy Yard in men who had been loading a ship and carrying heavy weights on the shoulder. Most authors also call attention to the fact that trauma may excite the symptoms.

I think that Dr. Grant is mistaken in saying that the fact that the patients shown by Dr. Erney have no other symptoms than pain leads him to doubt that it is due to the rudimentary ribs. Sargent in 1921, said he operated on several patients in whom pain was the only symptom.

Dr. E. H. Erney: The absence of more definite neurologic findings can be explained by the short time the patients have had symptoms, and if the pressure is continued over a longer period of time there will undoubtedly be more definite symptoms.

PARKINSONIAN SYNDROME IN EPIDEMIC ENCEPHALITIS AND IN PARALYSIS AGITANS. Dr. Alfred Gordon.

Case 1.—A woman, aged 35, had a typical attack of encephalitis several months ago. Six weeks ago she first came under observation and presented the following signs: masklike face, stiffness of the entire musculature of the upper part of the body, a fixed attitude in standing, walking or rising from a sitting posture. The steps were small; there was a loss of automatic movements and resistance to passive movements. There was a fine tremor of the hands, slight and intermittent and not especially characteristic. When the patient spoke she hardly moved her lips; the voice was low and montonous. She also presented excessive salivation, flushes of heat and pronounced sweating.

Cases 2 and 3.—Both patients were men, aged 60; they presented the course and symptoms of the ordinary paralysis agitans, namely, slow onset, hypertonia, the characteristic attitude and facies, gait, station and tremor.

In comparing the first case with the other two, some differences may be observed. In the former, we find a predominance of hypertonia over the tremor, and the hypertonia chiefly affects the facio-cervico-brachial region of the body. In paralysis agitans the tremor is the predominant feature and the hypertonia is uniformly spread all over the body. In the former, the face has not the frightened appearance of paralysis agitans, but rather the expression of suffering. The tremor in the former is slight and fugacious; in paralysis agitans it is coarse, constant and pill-rolling. In the former there is a persistent stiffness of the neck, increased salivation and obstinate headache, which are rarely observed in paralysis agitans.

The clinical differences are only a matter of degrees, as far as hypertonia and tremor are concerned. In paralysis agitans, the slow development corresponds to a gradual degeneration and subsequent atrophy of the neuron system of the striatum. Indeed Hunt, Jelgersma and others speak of atrophy of the striatal cells and radiation.

In encephalitis the disease is acute and infectious, attacks the vascular supply of the mid-brain and secondarily the cells of the basal ganglia. In the former the lesion is chronic, progressive and atrophic in type. In the latter it is at first of an irritative character.

A CASE OF BROWN-SEQUARD SYNDROME CAUSED BY A BULLET. Dr. A. M. Ornsteen.

A colored man was shot in the neck with a revolver bullet, which entered the neck slightly to the right of the median line anteriorly, and was found at operation on the left side in the large muscular mass over the left shoulder. The left lateral process of the sixth cervical vertebra was fractured, but the spinal canal was not penetrated. The first neurologic examination was made three weeks after the injury, and it was found that the patient had a left ulnar paralysis associated with a complete Horner's syndrome in the left eye. The left lower limb was spastic, with increased reflexes and a Babinski reflex. There were no deep sensibility disturbances in this limb. On the right side, there was

a disturbance in thermal and pain sense, including the whole lower extremity and extending up to the lower costal region. No motor involvement was apparent on this side.

This case was diagnosed as one of spinal concussion produced by the force of impact against the spinal column by the bullet, without penetration of the canal, classing it with those described by Lhermitte and Claude in the Presse méd., Oct. 7, 1918.

DISCUSSION

Dr. Williams B. Cadwalader: Paralysis of the limbs from pure contusion or concussion of the spinal cord, without penetration of the bullet into the spinal canal, was not rare during the late war. It was possible in some instances to make the diagnosis with certainty. The recognition of this condition is important, for a considerable degree of recovery can occur without surgical intervention.

DISSEMINATED SCLEROSIS WITH SYMPTOMS OF TUMOR OF THE MEDULLA OBLONGATA. Dr. John H. W. Rhein.

A woman, aged 31, presented a negative family and personal history, except that her father died of cancer of the liver. The symptoms began four years ago after an attack of influenza. She did not have diplopia or other symptoms pointing to epidemic encephalitis. After this attack she became dizzy, had difficulty in maintaining her balance, and complained of pain in the shoulders. At first frontal headaches and vomiting were present which were relieved by correction of refractive errors. Two years later she began to get weak in her left arm and leg, and four months ago her speech became affected. She choked when swallowing and there was regurgitation of fluids. She complained of pain in both sides of the neck, which extended to the occipital region, and the head began to turn to the right. Since that time the symptoms have gradually increased. She was seen on Nov. 8, 1923, when her condition was as follows: On examination, no paralysis of the ocular muscles was found. The left side of the mouth drooped. The tongue when protruded was pushed to the right. The uvula muscles on the right were relaxed, and the uvula was drawn slightly to the left. The masseter muscles contracted well on each side, and there was no sensory change in the face on either side. The left arm was slightly spastic and showed considerable loss of power. There was also an irregular coarse tremor which was slightly increased on voluntary effort. The arm jerks were increased. The dynamometer showed 65 on the right and 20 on the left. The left leg was spastic and weaker than the right. The knee jerks were increased on both sides, more on the left, and there was a Babinski sign on the left. The gait was spastic on the left side, and in walking the foot assumed the varus position. The Romberg sign was positive. Heel-to-knee test and finger-to-nose test on the left showed marked ataxia. The abdominal and epigastric reflexes were absent. There was adiadokokinesis of the left arm. The pin point was felt well on both sides, face, arms, trunk and legs. There was no involvement of the sphincters. The speech was slurring. The head turned to the right, and the chin pointed upward. The left sternocleidomastoid muscle was smaller than the right, and the muscles in the posterior cervical region on the left, as well as the left trapezius muscles, appeared to be smaller than on the right.

The pupils were equal and reacted promptly to light and in accommodation. Examination by Dr. Leighton F. Appelman showed healthy disks, normal fields, no nystagmus, no palsies, no scotomas. Examination by Dr. Ralph Butler showed

asymmetry of the fauces with some weakness of the left palatal arch. Both cords moved normally. The Bárány test by Dr. Lewis Fisher was as follows: The vestibular findings were not typical of any definite lesion but showed evidence of intracranial trouble. The responses suggested strongly a mass lesion rather than numerous small multiple lesions. The symptoms seemed to point to a lesion in the brain stem on the right side. The laboratory studies were practically negative. The cerebrospinal fluid as examined by Dr. D. J. McCarthy two years ago was negative. The head and the cervical region of the spinal column were examined with the roentgen ray with negative findings.

The diagnosis was either a neoplasm of the medulla oblongata or disseminated sclerosis. The symptoms which pointed to the first diagnosis were the cervical pain, torticollis, the atrophy of the neck muscles on the left, which was not definite, the weakness of the palatal muscles, the involvement of the speech, and weakness of the face, arm and leg on one side, all of which indicated a bulbar involvement. On the other hand, many of the symptoms favored a diagnosis of disseminated sclerosis, although all the symptoms of the Charcot triad were not present. There was no nystagmus and the tremor was not typically that of disseminated sclerosis. The spastic hemiplegia, the one-sided ataxia and tremor, the scanning speech, the mode of onset, the history of an infection preceding the onset, were indicative of disseminated sclerosis.

The question arises as to the advisability of operative procedure. In view, however, of the serious location of a growth that could give the symptoms presented in this case, and also the possibility of its being a disseminated sclerosis leads to the conclusion that the case should be continued under further observation before deciding to resort to operative procedures.

DISCUSSION

Dr. Charles S. Potts: I saw this patient and did not find any abdominal reflexes. I thought the patient's speech was rather characteristic of multiple sclerosis. I think she had many symptoms of that disease, although they were not inconsistent with tumor of the medulla.

Dr. D. J. McCarthy: Two years ago the patient had nystagmoid movements and an intention tremor on both sides. With the type of gait at the present time, the peculiar waddle, which Oppenheim describes, the general distribution of symptoms, and negative eye and spinal findings, I should still incline to the diagnosis of multiple sclerosis.

Dr. John H. W. Rhein: The possibility of a diagnosis of tumor of the medulla oblongata is indicated by the pain in the cervical region, torticollis, atrophy of the muscles of the neck, the hemiplegia and the weakness of the palatal muscles and tongue on the opposite side.

Dr. Spiller asked whether it might not be the result of an encephalitis. I was unable to elicit a history of any symptoms to indicate that diagnosis. The patient was clear about the onset of her illness. There was no diplopia, lethargy or any other symptoms which might point to a diagnosis of epidemic encephalitis. She said it began after an attack of influenza, although she had been nervous before. My own feeling is that it was a case of disseminated sclerosis presenting symptoms of tumor of the medulla oblongata.

A CASE OF AMYOTONIA CONGENITA. Dr. Temple Fay.

A child, aged 28 months, presenting general weakness and inability to walk had apparently been normal until about the seventh month, when the family

noticed that she did not use her legs as well as she should. The maternal history was negative; and the birth of the child was normal. Speech began at fourteen months and was now quite well established.

There was no evidence of glandular dysfunction, and, aside from this generalized weakness, the child had been apparently well. During gestation, the mother had suffered from ill health and had seldom eaten regularly and at times not for several days in succession.

Physical examination showed a well developed, alert child who cooperated readily, spoke and understood with a remarkable degree of intelligence. There were no cranial nerve involvements. The neck muscles were very weak, and it was difficult for the child to raise its head. Movements of the arms were voluntary and coordinated but showed little power; the grip was slight. The child did not move the lower extremities with any degree of satisfaction; she could not flex the knees or the thighs, or extend the legs when once flexed; there was profound atonia of all the muscle groups. The feet could be easily placed behind the head. All joints were very mobile, and there were no sensory disturbances and no atrophy of any muscle groups. There was loss of all the deep tendon reflexes. There was diminished electrical response in all the muscle groups, especially in the lower extremity where it was almost absent. The eyegrounds were negative, and the child showed no other abnormality. Constipation was, and had been, extreme at times.

DISCUSSION

Dr. Francis X. Dercum: I would suggest that in this case a roentgen-ray study be made of the thymus gland. It would be interesting to know whether or not the thymus is enlarged, and I would not be surprised if this were the case. The deficiency present is morphologic and is probably accompanied by an endocrine disturbance.

HEMIANESTHESIA AND COMPLETE ATONIC PARALYSIS DUE TO CEREBRAL LESION. Dr. Charles K. Mills.

Such neurologic signs as iridoplegia, the Babinski extensor reflex and persistent foot clonus of the nonspastic type are almost universally regarded as evidences of organic disease involving the pyramidal tracts. To these may be added the Tromner finger phenomenon, which seems to correspond for the upper extremities with the Babinski response in the lower, and also, as indicated in the cases to which reference will be made in the following notes, complete atonic or flaccid paralysis of the limbs. The Tromner reflex as described by Purves Stewart is "elicited by lightly flicking the terminal phalanx of the index finger in a palmar direction. In health, the patient's thumb remains motionless, but in disease of the pyramidal fibers of the upper limb, the thumb makes a reflex movement of adduction. A similar movement can also be elicited by firm, slow scratching along the ulnar side of the palm, from the base of the little finger towards the pisiform bone, or inversely."

A word might be said here about what is meant by complete atonic or flaccid paralysis. This is not simply the apparent or real inability to move the limb, a condition which may be present either in simulation or in hysterical paralysis. An atonic or flaccid limb is one which is in the truest sense "flail-like," as it is sometimes termed. It is not only helpless but completely relaxed as indicated by the state of the musculature and total relaxation at all the joints. Ample experience justifies me in saying that such flaccid palsy is always a sign of organic disease.

Recently in association with Dr. N. S. Yawger, I examined another case which I believe illustrated especially the point that complete flaccid or atonic palsy is a positive sign of organic disease of the brain. The man had been severely injured by a collision between two trolley cars. The results of the examination were briefly as follows:

The man was lying supine in the bed, irresponsive to any attempts to arouse him by his wife calling on him in his own language (the patient was a Pole) or otherwise. Examination of the upper right extremity showed a complete flaccid paralysis. The same was true of the right lower extremity. Deep reflexes both in the upper and lower extremities were all exaggerated. Sensations of touch, pain and temperature were all lost in the right half of the body; in other words, the patient was completely hemianesthetic. The Babinski reflex was not present. No response to plantar stimulation was elicited. He was not paralyzed on the left side. Plantar stimulation gave flexor response in the left foot, which exhibited slight clonus. A slight continuing patellar clonus was also elicited on the left. The Tromner finger phenomenon was present on the right. Abdominal and cremasteric reflexes were present on the right.

According to the attending physician and nurse, the man had had loss of bladder and rectal control. At first he had had incontinence of urine, but at present he had fairly good control at times, and occasionally not.

Dr. B. C. Gile reported that tests by tuning forks and otherwise indicated entire loss of hearing in the right ear and partial loss in the left, and also a ruptured membrane of the drum. The history indicated that he had had a hemorrhage from the left ear.

Dr. Johnson reported that the patient had had optic neuritis with some atrophy in the right eye, the disks being swollen, and not distinctly definable.

Examination showed a distinct depression a little to the left of the median line, nearly straight up from the left ear. The patient also showed evidences of a broken nose.

In this case the evidences of an organic injury to the brain were overwhelming. The patient had either had a hemorrhage or a series of hemorrhages associated with fractures, which were revealed by roentgen-ray examination. It is not impossible that he was slowly developing an abscess of the brain, similar to the first case, in which there was also a history of injury by a fall.

The complete loss of sensation apparently pointed to a deep seated lesion involving either the parietal lobe or the thalamus and extending forward so as to invade the pyramidal tract. Such a lesion would completely cut off the peripheral tonic innervation and probably was largely responsible for the absolute atonia.

The absence of the Babinski extensor reflex might have been regarded by some as evidence that the disease present in this case did not involve the pyramidal tracts, or that the case was not one of organic type. When, however, loss of sensation of organic type is present, even with invasion of the pyramidal tracts, the Babinski phenomenon is sometimes absent, while knee jerks and cutaneous and deep reflexes higher up in the body may be retained.

DISCUSSION

DR. CHARLES S. POTTS: I examined this patient before Dr. Mills, and the result of my examination on three occasions does not agree with his. I recognized that the man had a severe cerebral injury, and that the paralysis was on the opposite side from the site of the lesion, which would lead one to suspect the probability of an organic lesion causing these symptoms. I was not pre-

pared, however, to say that the symptoms were due to an organic lesion, for when I examined him he had a distinctly normal plantar reflex on both sides. Later when Dr. Mills saw him, he states that there was no response. If I had found the toes to be immovable instead of flexing, it might have made me doubtful; still other tests, such as Hoover's, gave a functional response. I could not account for the complete hemianesthesia on the left side, together with a motor paralysis. Of course a lesion of the thalamus could cause the hemianesthesia, but in addition either the cortex, subcortex or internal capsule would have to be involved to cause the motor paralysis. A lesion confined to the cortex or subcortex, which seemed to me to be the probable location of an organic lesion if he had one, could not cause his symptoms. Also, it seemed peculiar that there should be no motor paralysis of the face or tongue, and no motor aphasia, with a lesion as extensive as he must have had, if organic. Word blindness and the visual fields could not be tested.

For these reasons I could not convince myself that the motor and sensory paralysis were due to an organic lesion, although I recognized the possibility of organic lesions, such as may follow a cerebral concussion, being present.

A CASE OF ATAXIC PARAPLEGIA FOLLOWING EPIDEMIC ENCEPHALITIS. Dr. M. A. Burns.

This case is presented because of the rarity of similar symptoms following encephalitis. A white man, aged 21, was in good health until September, 1920, when his present complaint began, namely: a continuous tired feeling and weakness. The patient noticed that he had difficulty in jumping across the machine pit; a short time afterward he could not keep his balance without the aid of a cane. The weakness increased; the patient had to stop work in January, 1921, and became bedridden until May, 1921. During this period he was unable to move, and sensation was absent in the lower extremities. The temperature remained normal. The patient lacked interest in his surroundings during his illness. There was no disturbance of the sphincters.

In the latter part of April his legs began to "draw up." Diplopia was present for about eight months after the patient was able to get out of bed, and it was almost a year before the man was able to walk, first with the aid of crutches, and later with a cane. Jn January, 1923, he entered the Pennsylvania State College at which he remained until December, 1923, when he had to discontinue his college work on account of great difficulty in walking and loss of memory.

In 1918, at the age of 17, he had had influenza and suffered from pleurisy at the same time. In 1920, he had been hit between the eyes by a hammer and had been rendered unconscious for about half an hour.

Physical examination reveals a positive Romberg sign, markedly ataxic gait, increased reflexes, bilateral Babinski sign and a bilateral ankle clonus. Sensory examination revealed no loss.

Ophthalmologic examination revealed: Right eye: media clear, disk margins clear, broad cup; temporal half slate color; veins rather full. Left eye: media clear; disk margins clear, central cup; temporal half and nerve good color; veins full; pupils equal, regular and reacting to light and accommodation promptly; rotation unimpaired. The examination of the eyes and eyegrounds suggested an atrophy of the temporal portion of the right nerve.

Serologic Examination: The Wassermann test of the blood and spinal fluid was negative, eight cells per cubic millimeter.

From the history, the clinical course and observations, I believe that this case is one of ataxic paraplegia following epidemic encephalitis.

DISCUSSION

DR. FRANCIS X. DERCUM: I have seen in my clinic several such cases following encephalitis. This patient had rather a more marked spastic and ataxic symptom group than any other. The symptoms in his case were pronounced. Cord symptoms in encephalitis were, on the whole, infrequent, although they were present in a number of cases.

PARTIAL CONTINUOUS EPILEPSY WITH ESPECIAL REFERENCE TO THAT PRODUCED BY MICROSCOPIC CORTICAL LESIONS. DR. GEORGE WILSON and DR. N. W. WINKELMAN.

This paper will be published in full in the ARCHIVES.

News and Comment

AMERICAN NEUROLOGICAL ASSOCIATION—FIFTIETH ANNIVERSARY MEETING

The fiftieth annual meeting of the American Neurological Association will be held in Philadelphia on Thursday, Friday and Saturday, June 5, 6 and 7, 1924.